MITSUBISHI

General-Purpose AC Servo

MELSERVO-J2-Jr Series

General-Purpose Interface
MR-J2-03A5
Servo Amplifier
Instruction Manual

MITSUBISHI ELECTRIC B

● Safety Instructions ●

(Always read these instructions before using the equipment.)

Do not attempt to install, operate, maintain or inspect the servo amplifier and servo motor until you have read through this Instruction Manual, Installation guide, Servo motor Instruction Manual and appended documents carefully and can use the equipment correctly. Do not use the servo amplifier and servo motor until you have a full knowledge of the equipment, safety information and instructions.
In this Instruction Manual, the safety instruction levels are classified into "WARNING" and "CAUTION".

⚠ WARNING	Indicates that incorrect handling may cause hazardous conditions,, resulting in death or severe injury.
⚠ CAUTION	Indicates that incorrect handling may cause hazardous conditions,, resulting in medium or slight injury to personnel or may cause physical damage.

Note that the CAUTION level may lead to a serious consequence according to conditions. Please follow the instructions of both levels because they are important to personnel safety.
What must not be done and what must be done are indicated by the following diagrammatic symbols:

⃠: Indicates what must not be done. For example, "No Fire" is indicated by ⃠.
●: Indicates what must be done. For example, grounding is indicated by ⏚.

In this Instruction Manual, instructions at a lower level than the above, instructions for other functions, and so on are classified into "POINT".
After reading this installation guide, always keep it accessible to the operator.

1. To prevent electric shock, note the following:

⚠ WARNING

- Before wiring or inspection, switch power off and wait for more than 10 minutes. Then, confirm the voltage is safe with voltage tester. Otherwise, you may get an electric shock.
- Connect the servo amplifier and servo motor to ground.
- Any person who is involved in wiring and inspection should be fully competent to do the work.
- Do not attempt to wire the servo amplifier and servo motor until they have been installed. Otherwise, you may get an electric shock.
- Operate the switches with dry hand to prevent an electric shock.
- The cables should not be damaged, stressed loaded,, or pinched. Otherwise, you may get an electric shock.

2. To prevent fire, note the following:

⚠ CAUTION

- Do not install the servo amplifier, servo motor and regenerative brake resistor on or near combustibles. Otherwise a fire may cause.
- When the servo amplifier has become faulty, switch off the main servo amplifier power side. Continuous flow of a large current may cause a fire.

3. To prevent injury, note the follow

⚠ CAUTION

- Only the voltage specified in the Instruction Manual should be applied to each terminal,, Otherwise,, a burst,, damage,, etc. may occur.
- Connect the terminals correctly to prevent a burst,, damage,, etc.
- Ensure that polarity (+, –) is correct. Otherwise, a burst, damage, etc. may occur.
- During power-on or for some time after power-off, do not touch the servo motor. Their temperatures may be high and you may get burnt.

4. Additional instructions

The following instructions should also be fully noted. Incorrect handling may cause a fault, injury, electric shock, etc.

(1) Transportation and installation

⚠ CAUTION

- Transport the products correctly according to their weights.
- Stacking in excess of the specified number of products is not allowed.
- Do not carry the motor by the cables, shaft or encoder.
- Do not hold the front cover to transport the controller. The controller may drop.
- Install the servo amplifier in a load-bearing place in accordance with the Instruction Manual.
- Do not climb or stand on servo equipment. Do not put heavy objects on equipment.
- The controller and servo motor must be installed in the specified direction.
- Leave specified clearances between the servo amplifier and control enclosure walls or other equipment.
- Do not install or operate the servo amplifier and servo motor which has been damaged or has any parts missing.
- Provide adequate protection to prevent screws and other conductive matter, oil and other combustible matter from entering the servo amplifier.
- Do not drop or strike servo amplifier or servo motor. Isolate from all impact loads.
- Use the servo amplifier and servo motor under the following environmental conditions:

Environment		Conditions		
		Servo Amplifier	Servo Motor	
Ambient temperature	[°C]	0 to +55 (non-freezing)	0 to +40 (non-freezing)	
	[°F]	32 to 131 (non-freezing)	32 to 104 (non-freezing)	
Ambient humidity		90%RH or less (non-condensing)	80%RH or less (non-condensing)	
Storage temperature	[°C]	-20 to +65 (non-freezing)	-15 to +70 (non-freezing)	
	[°F]	-4 to 149 (non-freezing)	5 to 158 (non-freezing)	
Storage humidity		90%RH or less (non-condensing)		
Ambience		Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt		
Altitude		Max. 1000m (3280 ft) above sea level		
Vibration	[m/s^2]	5.9 {0.6G} or less	HC-AQ Series	X · Y : 19.6 {2G}
	[ft/s^2]	19.4 or less	HC-AQ Series	X · Y : 64

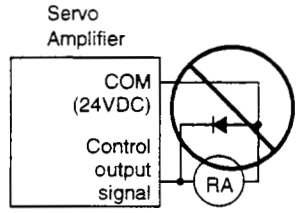
⚠ CAUTION

- Securely attach the servo motor to the machine. If attach insecurely, the servo motor may come off during operation.
- The servo motor with reduction gear must be installed in the specified direction to prevent oil leakage.
- For safety of personnel, always cover rotating and moving parts.
- Never hit the servo motor or shaft, especially when coupling the servo motor to the machine. The encoder may become faulty.
- Do not subject the servo motor shaft to more than the permissible load. Otherwise, the shaft may break.
- When the equipment has been stored for an extended period of time, consult Mitsubishi.

(2) Wiring

⚠ CAUTION

- Wire the equipment correctly and securely. Otherwise, the servo motor may misoperate.
- Do not install a power capacitor, surge absorber or radio noise filter between the servo motor and servo amplifier.
- Connect the output terminals (U, V, W) correctly. Otherwise, the servo motor will operate improperly.
- Do not connect AC power directly to the servo motor. Otherwise, a fault may occur.
- The surge absorbing diode installed on the DC output signal relay must be wired in the specified direction. Otherwise, the emergency stop and other protective circuits may not operate.



(3) Test run adjustment

⚠ CAUTION

- Before operation, check the parameter settings. Improper settings may cause some machines to perform unexpected operation.
- The parameter settings must not be changed excessively. Operation will be instable.

(4) Usage

⚠ CAUTION

- Provide an external emergency stop circuit to ensure that operation can be stopped and power switched off immediately.
- Any person who is involved in disassembly and repair should be fully competent to do the work.
- Before resetting an alarm, make sure that the run signal is off to prevent an accident. A sudden restart is made if an alarm is reset with the run signal on.
- Do not modify the equipment.
- Use a noise filter, etc. to minimize the influence of electromagnetic interference, which may be caused by electronic equipment used near the servo amplifier.
- Use the servo amplifier with the specified servo motor.
- The electromagnetic brake on the servo motor is designed to hold the motor shaft and should not be used for ordinary braking.
- For such reasons as service life and mechanical structure (e.g. where a ballscrew and the servo motor are coupled via a timing belt), the electromagnetic brake may not hold the motor shaft. To ensure safety, install a stopper on the machine side.

(5) Corrective actions

⚠ CAUTION

- When it is assumed that a hazardous condition may take place at the occur due to a power failure or a product fault, use a servo motor with electromagnetic brake or an external brake mechanism for the purpose of prevention.
- When any alarm has occurred, eliminate its cause, ensure safety, and deactivate the alarm before restarting operation.
- When power is restored after an instantaneous power failure, keep away from the machine because the machine may be restarted suddenly (design the machine so that it is secured against hazard if restarted).

(6) Maintenance, inspection and parts replacement

⚠ CAUTION

- With age, the electrolytic capacitor will deteriorate. To prevent a secondary accident due to a fault, it is recommended to replace the electrolytic capacitor every 10 years when used in general environment.

(7) Disposal

⚠ CAUTION
•Dispose of the product as general industrial waste.

(8) General instruction

•To illustrate details, the equipment in the diagrams of this Instruction Manual may have been drawn without covers and safety guards. When the equipment is operated, the covers and safety guards must be installed as specified. Operation must be performed in accordance with this Instruction Manual.

COMPLIANCE WITH EC DIRECTIVES

1. WHAT ARE EC DIRECTIVES?

The EC Directives were issued to standardize the regulations of the EU countries and ensure smooth distribution of safety-guaranteed products. In the EU countries, the Machinery Directive (effective in January, 1995), EMC Directive (effective in January, 1996) and Low Voltage Directive (effective in January, 1997) of the EC Directives require that products to be sold should meet their fundamental safety requirements and carry the CE marks (CE marking). CE marking applies to machines and equipment into which servo amplifiers have been installed.

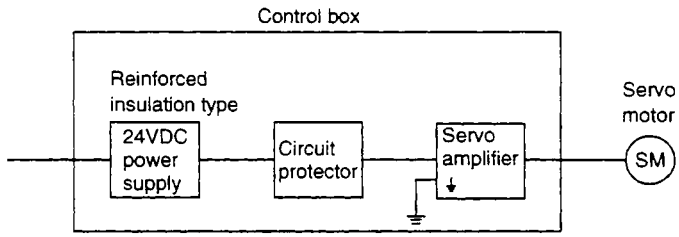
The servo amplifiers do not function independently but are designed for use with machines and equipment. Therefore, the CE marking does not apply to the servo amplifiers but applies to the machines and equipment into which the servo amplifiers are installed.

This servo amplifier conforms to the standards related to the Low Voltage Directive to facilitate CE marking on machines and equipment into which the servo amplifiers will be installed. To ensure ease of compliance with the EMC Directive, Mitsubishi Electric prepared the "EMC INSTALLATION GUIDELINES" (IB(NA)67310) which provides servo amplifier installation, control box making and other procedures. Please contact your sales representative.

2. PRECAUTIONS FOR COMPLIANCE

The standard models of the servo amplifier and servo motor comply with the EN Standard. In addition to the instructions provided in this Instruction Manual, also follow the instructions below. If the model is not specifically described to comply with the EN Standard in this Instruction Manual, it has the same specifications as those of the standard models:

(1) Structure



(2) Environment

Operate the servo amplifier at or above the contamination level 2 set forth in IEC664. For this purpose, install the servo amplifier in a control box which is protected against water, oil, carbon, dust, dirt, etc. (IP54).

(3) Power supply

Use a 24VDC power supply which has been insulation-reinforced in I/O.

(4) Grounding

To prevent an electric shock, fit the supplied earth terminal (E) to the servo amplifier and always connect it to the earth (E) of the control box.

(5) Auxiliary equipment and options

(a) The circuit protector used should be the EN or IEC Standard-compliant product of the model described in Section 12.2.2.

(b) The sizes of the cables described in Section 12.2.2 meet the following requirements. To meet the other requirements, follow Table 5 and Appendix C in EN60204.

- Ambient temperature: 40 (104) [°C (°F)]
- Sheath: PVC (polyvinyl chloride)
- Installed on wall surface or open table tray

(6) Performing EMC tests

When EMC tests are run on a machine/device into which the servo amplifier has been installed, it must conform to the electromagnetic compatibility (immunity/emission) standards after it has satisfied the operating environment/electrical equipment specifications.

For the other EMC Directive guidelines on the servo amplifier, refer to the "EMC INSTALLATION GUIDELINES".

CONFORMANCE WITH UL/C-UL STANDARD

The standard models of the servo amplifier and servo motor comply with the UL/C-UL Standard.
Unless otherwise specified, the handling, performance, specifications, etc. of the UL/C-UL Standard-compliant models are the same as those of the standard models.
When using 24VDC power supply, options and auxiliary equipment, use those which conform to the UL/C-UL Standard.

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Optional Servo Motor Instruction Manual CONTENTS

The rough table of contents of the optional MELSERVO Servo Motor Instruction Manual is introduced here for your reference. Note that the contents of the Servo Motor Instruction Manual are not included in the Servo Amplifier Instruction Manual.

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2. INSTALLATION

3. CONNECTORS USED FOR SERVO MOTOR WIRING

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About the Manuals

This Instruction Manual and the MELSERVO Servo Motor Instruction Manual are required if you use the General-Purpose AC servo MR-J2-03A5 for the first time. Always purchase them and use the MR-J2-03A5 safely.

Relevant manuals

Manual Name	Manual No.
MELSERVO-J2-Jr Series Installation Guide	IB(NA)67426
MELSERVO Servo Motor Instruction Manual	SH(NA)3181 (Ver-C or later)
EMC Installation Guidelines	IB(NA)67310

1. FUNCTIONS AND CONFIGURATION

1.1 Introduction

The MELSERVO-J2-Jr series general-purpose AC servo has been developed as an ultracompact, small capacity servo system compatible with the MELSERVO-J2 series 24VDC power supply. It can be used in a wide range of fields from semiconductor equipment to small robots, etc.
The input signals of the servo amplifier control system are compatible with those of the MR-J2-□A.
As the standard models comply with the EN Standard · UL/C-UL Standard, they can be used satisfactorily in various countries.
The MR-J2-03A5 servo amplifier can be easily installed to a control box with a DIN rail.
The power supply/electromagnetic brake and encoder of the servo motor can be wired easily with a single cable.
Using a personal computer where the Servo Configuration software has been installed, you can make parameter setting, status display, etc.
Also, you can use the RS-422 communication function to set up to 32 axes of servo amplifiers.
The compatible servo motors have achieved the smallest 28mm-bore flange size in this class and are further equipped with encoders of 8192 pulses/rev (incremental) resolution.

1.2 Function List

The following table lists the functions of the MR-J2-03A5. For details of the functions, refer to the corresponding chapters and sections.

Function	Description	(Note) Control Mode	Refer To
Position control mode	MR-J2-03A5 is used as position control servo.	P	Section 3.1.1 Section 3.4.1 Section 4.2.2
Speed control mode	MR-J2-03A5 is used as speed control servo.	S	Section 3.1.2 Section 3.4.2 Section 4.2.3
Torque control mode	MR-J2-03A5 is used as torque control servo.	T	Section 3.1.3 Section 3.4.3 Section 4.2.4
Position/speed control change mode	Using external input signal, control can be switched between position control and speed control.	P/S	Section 3.4.4
Speed/torque control change mode	Using external input signal, control can be switched between speed control and torque control.	S/T	Section 3.4.5
Torque/position control change mode	Using external input signal, control can be switched between torque control and position control.	T/P	Section 3.4.6
Slight vibration suppression control	Suppresses vibration of ±1 pulse produced at a servo motor stop.	P	Section 7.5
Electronic gear	Input pulses can be multiplied by 1/50 to 50.	P	Parameters No. 3, 4
Real-time auto tuning	Automatically adjusts the gain to optimum value if load applied to the servo motor shaft varies.	P, S	Section 7.3 Parameter No. 2
Smoothing	Speed can be increased smoothly in response to input pulse.	P	Parameter No. 7
S-pattern acceleration/ deceleration time constant	Speed can be increased and decreased smoothly.	S	Parameter No. 13
Alarm history clear	Alarm history is cleared.	P, S, T	Parameter No. 16
Restart after instantaneous power failure	If the input power supply voltage had reduced to cause an alarm but has returned to normal, the servo motor can be restarted by merely switching on the start signal.	S	Parameter No. 20
Command pulse selection	Command pulse train form can be selected from among four different types.	P	Parameter No. 21
Input signal selection	Forward rotation start, reverse rotation start, servo on and other input signals can be assigned to any pins.	P, S, T	Parameters No. 43 to 48
Torque limit	Servo motor-generated torque can be limited to any value.	P, S	Section 3.4.1 (2) Parameter No. 28
Speed limit	Servo motor speed can be limited to any value.	T	Section 3.4.3 (3) Parameter No. 8 to 10
Status display	Servo status is shown on the 4-digit, 7-segment LED display	P, S, T	Section 6.2
External I/O display	ON/OFF statuses of external I/O signals are shown on the display.	P, S, T	Section 6.6
Output signal forced output	Output signal can be forced on/off independently of the servo status. Use this function for output signal wiring check, etc.	P, S, T	Section 6.7
Automatic VC offset	Voltage is automatically offset to stop the servo motor if it does not come to a stop at the analog speed command (VC) or analog speed limit (VLA) of 0V.	S, T	Section 6.3
Test operation mode	Servo motor can be run from the operation section of the servo amplifier without the start signal entered.	P, S, T	Section 6.8

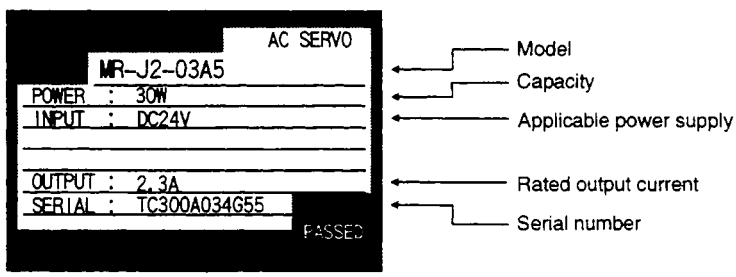
Function	Description	(Note) Control Mode	Refer To
Servo configuration software	Using a personal computer, parameter setting, test operation, status display, etc. can be performed.	P, S, T	Section 12.1.3
Alarm code output	If an alarm has occurred, the corresponding alarm number is output in 3-bit code.	P, S, T	Section 9.2.1

Note: P: Position control mode, S: Speed control mode, T: Torque control mode

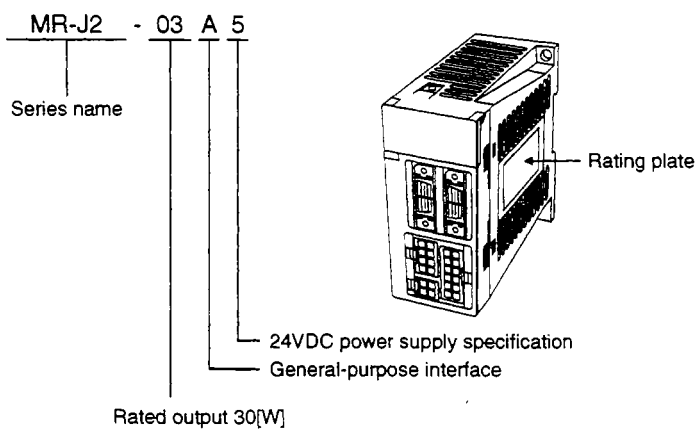
P/S: Position/speed control change mode, S/T: Speed/torque control change mode, T/P: Torque/position control change mode

1.3 Model Code Definition

(1) Rating plate



(2) Model



1.4 Combination with Servo Motor

The HC-AQ series servo motors can be used. The same combinations apply to the servo motors provided with electromagnetic brakes and reduction gears.

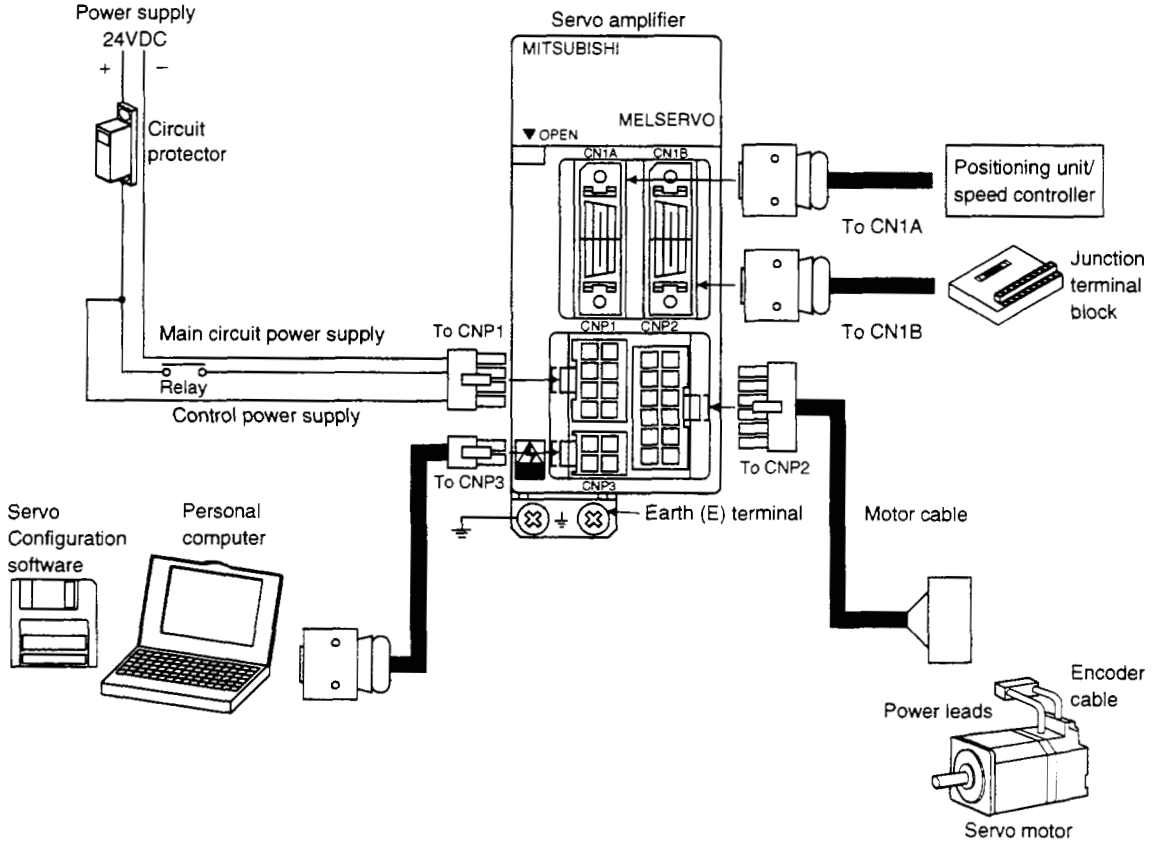
Servo Amplifier	Servo motor
MR-J2-03A5	HC-AQ0135D
	HC-AQ0235D
	HC-AQ0335D

1.5 Parts Identification

Name/Application	Refer To
Display The four-digit, seven-segment LED shows the servo status and alarm number.	Chapter6
Operation section Used to perform status display, diagnostic, alarm and parameter operations. MODE UP DOWN SET Used to set parameter data. Used to change the display or data in each mode. Used to change the mode.	Chapter6
I/O signal connector (CN1A) Used to connect digital I/O signals.	Section3.3
I/O signal connector (CN1B) Used to connect digital I/O signals.	Section3.3
Name plate	Section1.3
Servo motor connector (CNP2) Connector for connection of the servo motor.	Section3.3 Section10.2.1 Section12.1.1
Power input connector (CNP1) Used to connect the input power supply/control circuit power supply/RS-422.	Section3.3 Section10.2.1
Communication connector (CNP3) Used for connection with a personal computer (RS-232C).	Section3.3 Section10.2.1 Section12.1.3
Earth (E) terminal (⏚) To conform to the EN Standard, fit the supplied earth terminal for grounding.	Section3.9

1.6 Servo System with Auxiliary Equipment

> **⚠ WARNING**
>
> • To prevent an electric shock, fit the supplied earth terminal (E) to the servo amplifier (refer to (2), Section 3.9) and always connect it to the earth (E) of the control box.



2. INSTALLATION

⚠ CAUTION

- Stacking in excess of the limited number of products is not allowed.
- Install the equipment to incombustible. Installing them directly or close to combustibles will led to a fire.
- Install the equipment in a load-bearing place in accordance with this Instruction Manual.
- Do not get on or put heavy load on the equipment to prevent injury.
- Use the equipment within the specified environmental condition range.
- Provide an adequate protection to prevent screws, metallic detritus and other conductive matter or oil and other combustible matter from entering the servo amplifier.
- Do not block the intake/exhaust ports of the servo amplifier. Otherwise, a fault may occur.
- Do not subject the servo amplifier to drop impact or shock loads as they are precision equipment.
- Do not install or operate a faulty servo amplifier.
- When the product has been stored for an extended period of time, consult Mitsubishi.

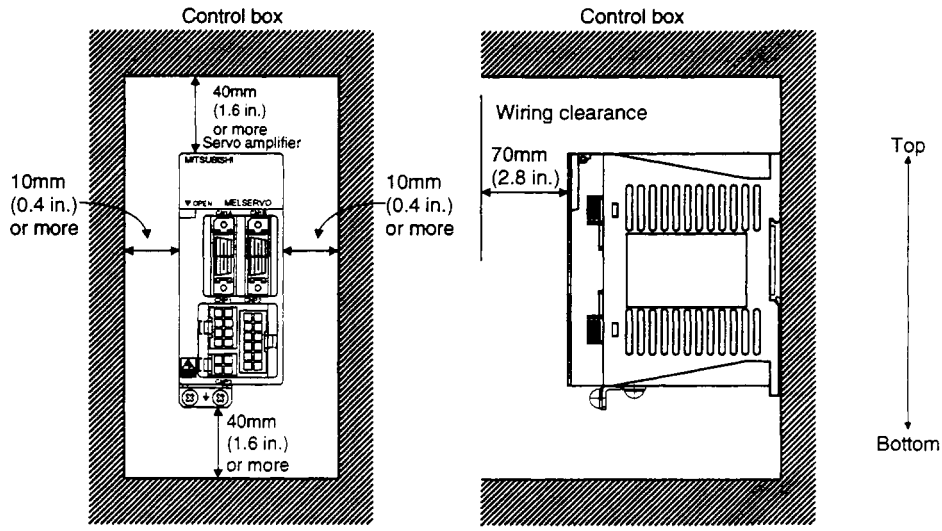
2.1 Environmental conditions

Environment	Conditions
Ambient temperature	0 to +55 [°C] (non-freezing)
	32 to +131 [°F] (non-freezing)
Ambient humidity	90%RH or less (non-condensing)
storage temperature	−20 to +65 [°C] (non-freezing)
	−4 to +149 [°F] (non-freezing)
storage humidity	90%RH or less (non-condensing)
Ambient	Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt
Altitude	Max. 1000m (3280 ft) above sea level
Vibration	5.9 [m/s^2] {0.6G} or less
	19.4 [ft/s^2] or less

2.2 Installation direction and clearances

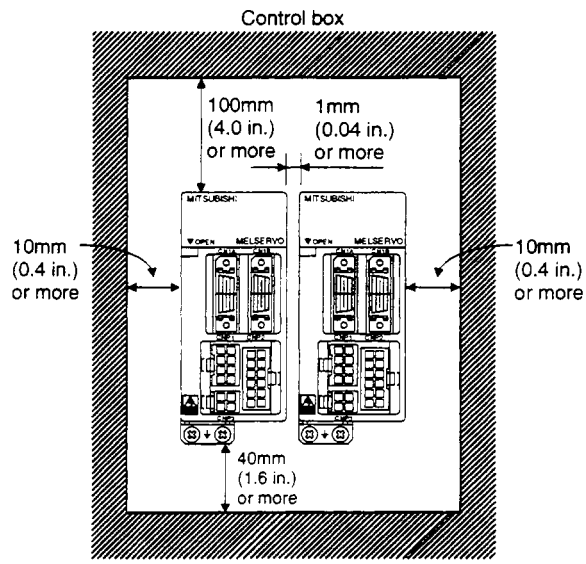
> **⚠ CAUTION**
>
> - The equipment must be installed in the specified direction. Otherwise, a fault may occur.
> - Leave specified clearances between the servo amplifier and control box inside walls or other equipment.

(1) Installation of one servo amplifier



(2) Installation of two or more servo amplifiers

Leave a large clearance between the top of the servo amplifier and the internal surface of the control box, and install a fan to prevent the internal temperature of the control box from exceeding the environmental conditions.



(3) Others

Install the servo amplifier on a perpendicular wall in the correct vertical direction.

2.3 Keep out foreign materials

(1) When installing the unit in a control box, prevent drill chips and wire fragments from entering the servo amplifier.
(2) Prevent oil, water, metallic dust, etc. from entering the servo amplifier through openings in the control box or a fan installed on the ceiling.
(3) When installing the control box in a place where there are toxic gas, dirt and dust, provide positive pressure in the control box by forcing in clean air to prevent such materials from entering the control box.

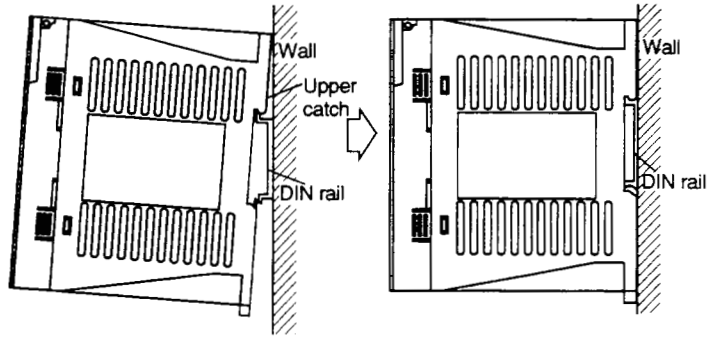
2.4 Cable stress

(1) The way of clamping the cable must be fully examined so that flexing stress and cable's own weight stress are not applied to the cable connection.
(2) In any application where the servo motor moves, the cables should be free from excessive stress. For use in any application where the servo motor moves, run the cables so that their flexing portions fall within the optional motor cable range. Fix the motor cable and power lead of the servo motor.
(3) Avoid any probability that the cable sheath might be cut by sharp chips, rubbed by a machine corner or stamped by workers or vehicles.
(4) For installation on a machine where the servo motor will move, the flexing radius should be made as large as possible. Refer to section 11.4 for the flexing life.

2.5 Using the DIN rail for installation

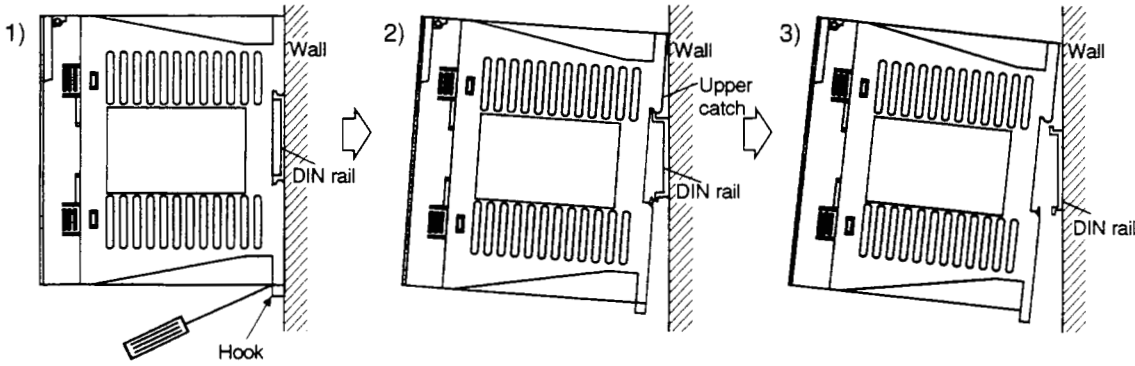
(1) Fitting into the DIN rail

Put the upper catch on the DIN rail and push the unit until it clicks.



(2) Removal from DIN rail

1) Pull down the hook.
2) Pull it toward you.
3) Lift and remove the unit.



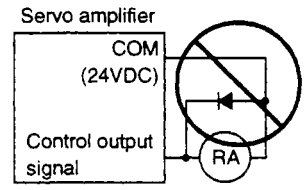
3. SIGNALS AND WIRING

⚠ WARNING

- Any person who is involved in wiring should be fully competent to do the work.
- Before starting wiring, make sure that the voltage is safe in the tester more than 10 minutes after power-off. Otherwise, you may get an electric shock.
- Ground the servo amplifier and the servo motor securely.
- Do not attempt to wire the servo amplifier and servo motor until they have been installed. Otherwise, you may get an electric shock.
- The cables should not be damaged, stressed excessively, loaded heavily, or pinched. Otherwise, you may get an electric shock.

⚠ CAUTION

- Wire the equipment correctly and securely. Otherwise, the servo motor may misoperate, resulting in injury.
- Connect cables to correct terminals to prevent a burst, fault, etc.
- Ensure that polarity (+, –) is correct. Otherwise, a burst, damage, etc. may occur.
- The surge absorbing diode installed to the DC relay designed for control output should be fitted in the specified direction. Otherwise, the signal is not output due to a fault, disabling the forced stop and other protective circuits.



- Use a noise filter, etc. to minimize the influence of electromagnetic interference, which may be given to electronic equipment used near the servo amplifier.
- Do not install a power capacitor, surge suppressor or radio noise filter with the power line of the servo motor.
- Do not modify the equipment.

POINT

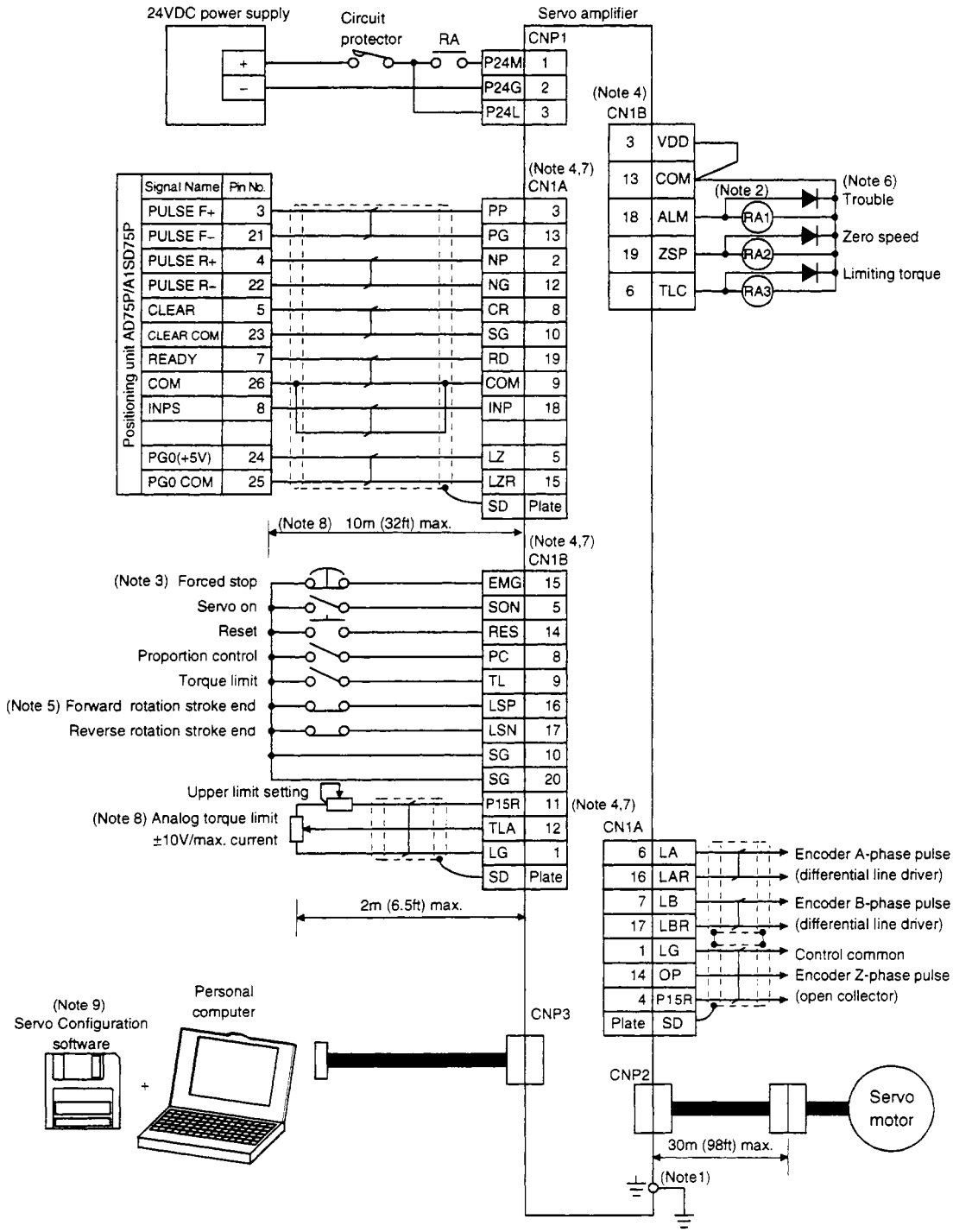
CN1A and CN1B have the same shape. Wrong connection of the connectors will lead to a failure. Connect them correctly.

3.1 Standard connection example

POINT

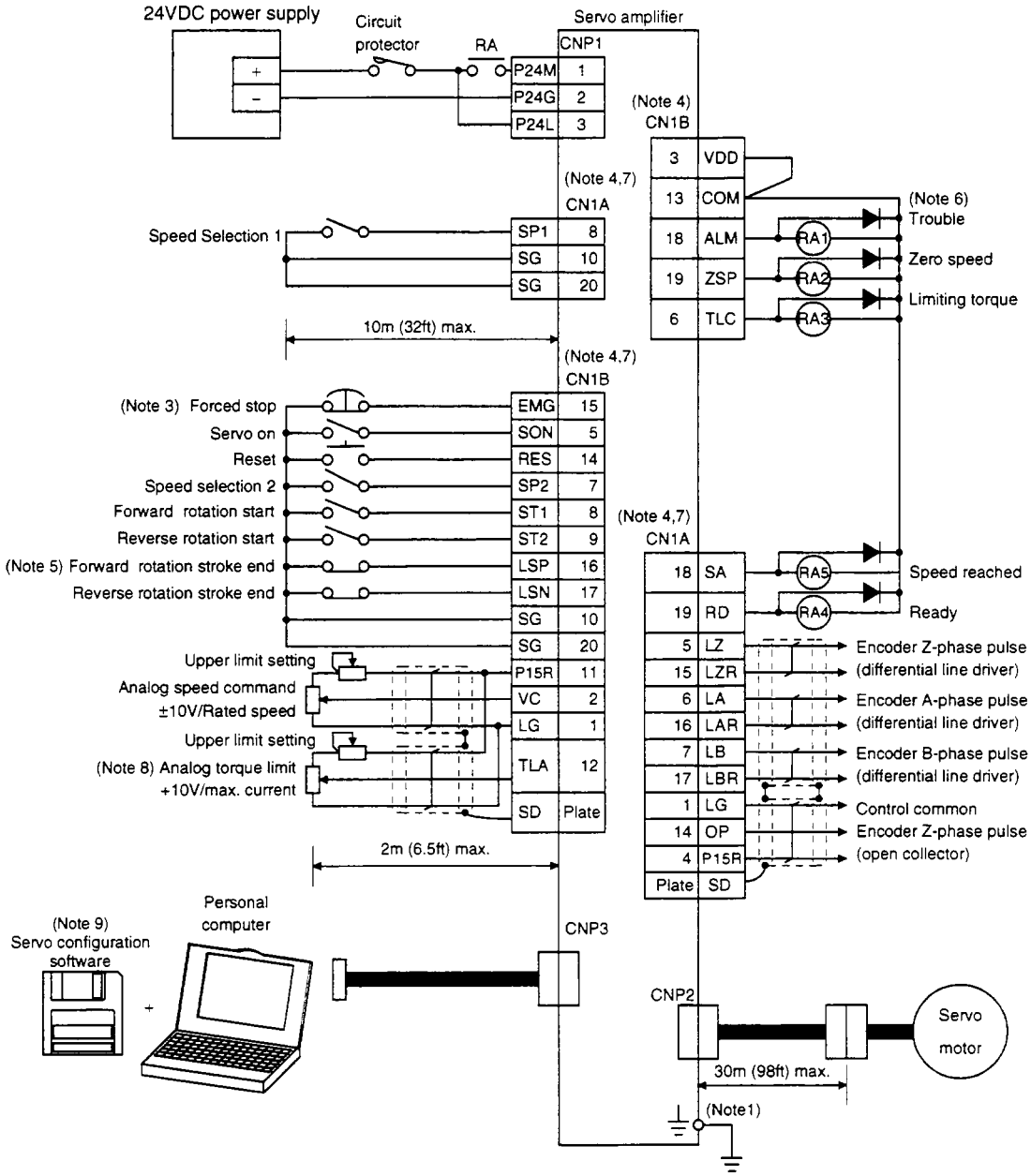
- For the connection of the power supply system, refer to Section 3.7.1.

3.1.1 Position control mode AD75P□ (A1SD75P□)



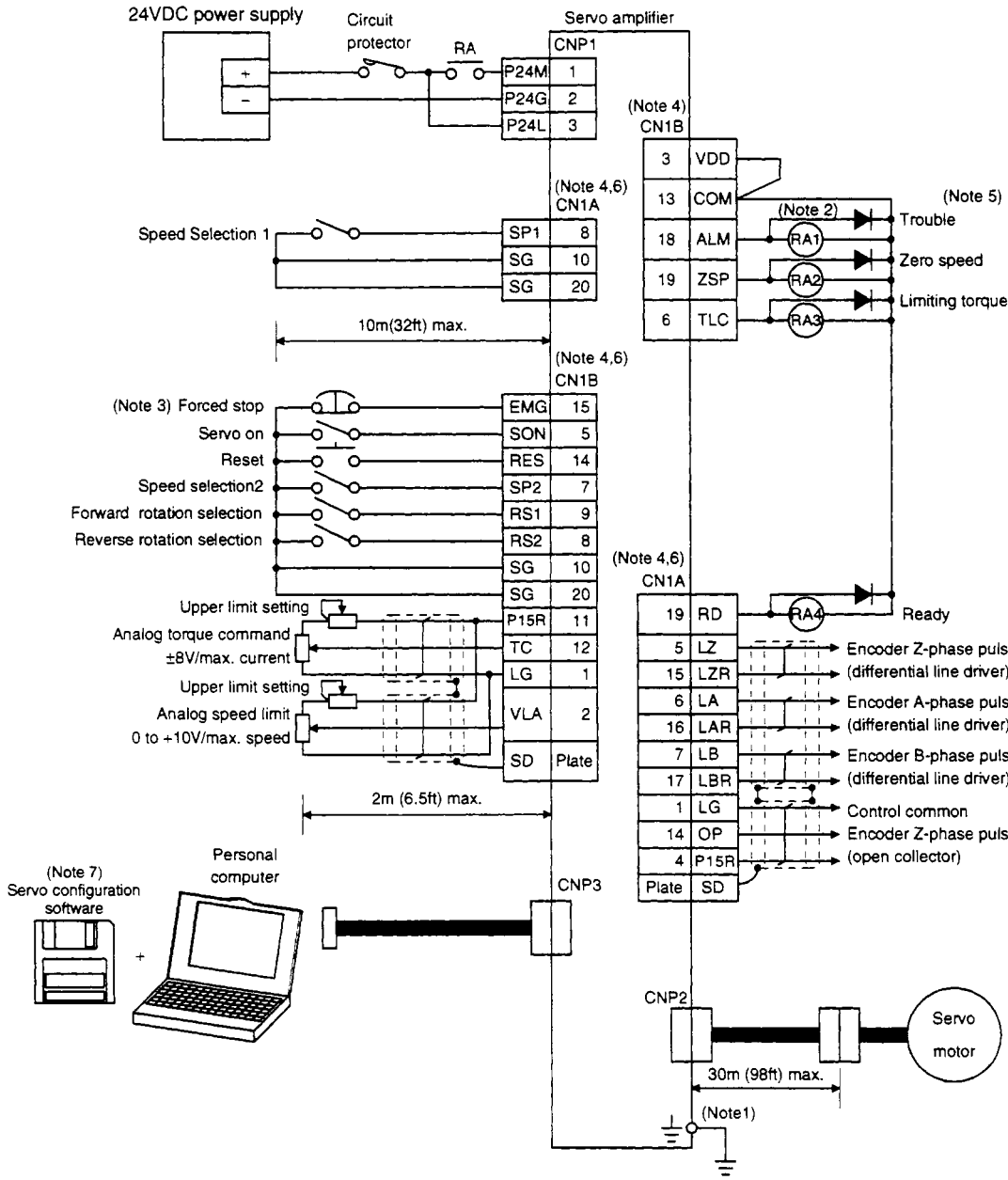
Note: 1. To prevent an electric shock, fit the supplied earth terminal (E) to the servo amplifier and always connect it to the earth (E) of the control box. (Refer to section 3.9.)
2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will be faulty and will not output signals, disabling the forced stop and other protective circuits.
3. The forced stop switch must be installed.
4. CN1A and CN1B have the same shape. Wrong connection of the connectors will lead to a fault.
5. When starting operation, always connect the forward/reverse rotation stroke end signal (LSN/LSP) with SG. (Normally closed contacts)
6. Trouble (ALM) is connected with COM in normal alarm-free condition.
7. The pins with the same signal name are connected in the servo amplifier.
8. For the command pulse train input of the differential line driver system. 2m max. for the open collector system.
9. Use MRZJW3-SETUP61E or later.

3.1.2 Speed control mode



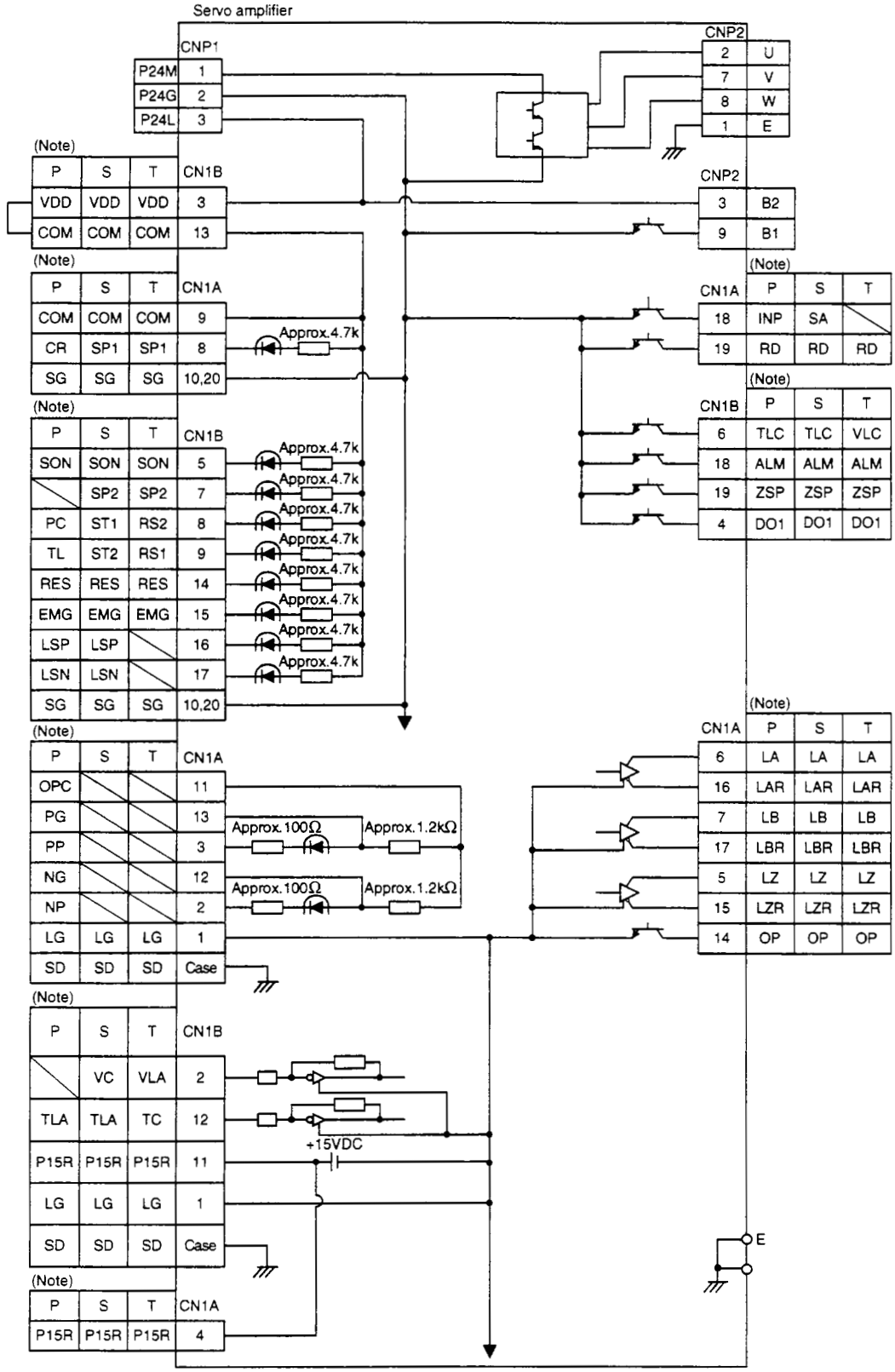
Note: 1. To prevent an electric shock, fit the supplied earth terminal (E) to the servo amplifier and always connect it to the earth (E) of the control box. (Refer to section 3.9.)
2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will be faulty and will not output signals, disabling the forced stop and other protective circuits.
3. The forced stop switch must be installed.
4. CN1A and CN1B have the same shape. Wrong connection of the connectors will lead to a fault.
5. When starting operation, always connect the forward/reverse rotation stroke end signal (LSN/LSP) with SG. (Normally closed contacts)
6. Trouble (ALM) is connected with COM in normal alarm-free condition.
7. The pins with the same signal name are connected in the servo amplifier.
8. TLA can be used by setting any of parameters No. 43 to 48 to make TL available.
9. Use MRZJW3-SETUP61E or later.

3.1.3 Torque control mode



Note: 1. To prevent an electric shock, fit the supplied earth terminal (E) to the servo amplifier and always connect it to the earth (E) of the control box. (Refer to section 3.9.)
2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will be faulty and will not output signals, disabling the forced stop and other protective circuits.
3. The forced stop switch must be installed.
4. CN1A and CN1B have the same shape. Wrong connection of the connectors will lead to a fault.
5. Trouble (ALM) is connected with COM in normal alarm-free condition.
6. The pins with the same signal name are connected in the servo amplifier.
7. Use MRZJW3-SETUP61E or later.

3.2 Internal Connection Diagram of Servo Amplifier



Note. P: Position control mode, S: Speed control mode, T: Torque control mode

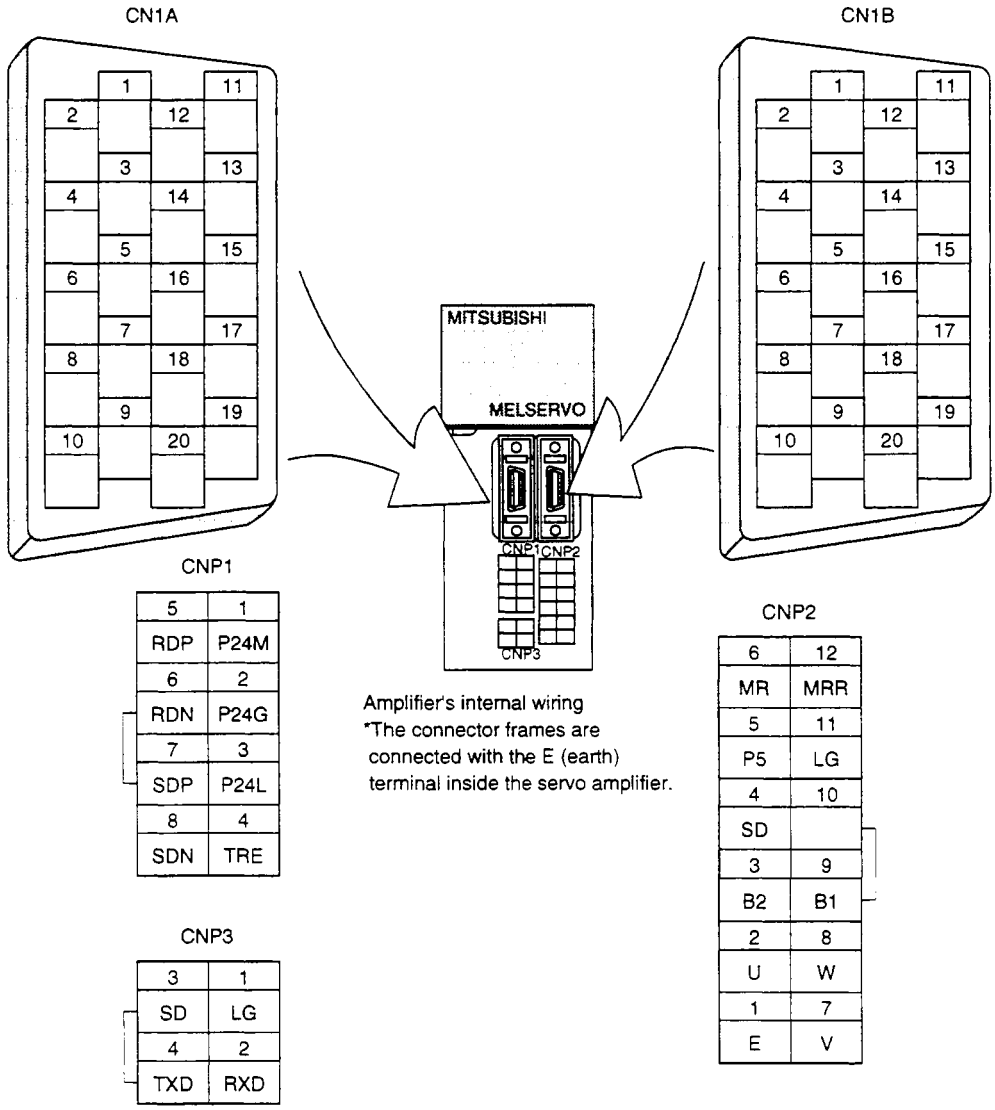
3.3 I/O Signals

3.3.1 Connectors and signal arrangements

POINT

- The connector pin-outs shown above are viewed from the cable connector wiring section side.
- Refer to the next page for CN1A and CN1B signal assignment.

(1) Signal arrangement



CNP1

5	1
RDP	P24M
6	2
RDN	P24G
7	3
SDP	P24L
8	4
SDN	TRE

CNP3

3	1
SD	LG
4	2
TXD	RXD

CNP2

6	12
MR	MRR
5	11
P5	LG
4	10
SD	
3	9
B2	B1
2	8
U	W
1	7
E	V

(2) CN1A and CN1B signal assignment

The signal assignment of connector changes with the control mode as indicated below;

Connector	Pin No.	(Note1) I/O	(Note2) I/O Signals in Control Modes					
			P	P/S	S	S/T	T	T/P
CN1A	1	—	LG	LG	LG	LG	LG	LG
	2	I	NP	NP/—				— /NP
	3	I	PP	PP/—				— /PP
	4	—	P15R	P15R/P15R	P15R	P15R	P15R	P15R
	5	O	LZ	LZ	LZ	LZ	LZ	LZ
	6	O	LA	LA	LA	LA	LA	LA
	7	O	LB	LB	LB	LB	LB	LB
	(Note8)8	I	CR	CR/SP1	(Note3)SP1	SP1/SP1	(Note3)SP1	SP1/CR
	9	—	COM	COM	COM	COM	COM	COM
	10	—	SG	SG	SG	SG	SG	SG
	11	—	OPC	OPC/—				— /OPC
	12	I	NG	NG/G				— /NG
	13	I	PG	PG/—				— /PG
	14	O	OP	OP	OP	OP	OP	OP
	15	O	LZR	LZR	LZR	LZR	LZR	LZR
	16	O	LAR	LAR	LAR	LAR	LAR	LAR
	17	O	LBR	LBR	LBR	LBR	LBR	LBR
	(Note7,9)18	O	INP	INP/SA	SA	SA/—		— /INP
	(Note7,9)19	O	RD	RD	RD	RD	RD	RD
	20	—	SG	SG	SG	SG	SG	SG
CN1B	1	—	LG	LG	LG	LG	LG	LG
	2	I		— /VC	VC	VC/VLA	VLA	VLA/—
	3	—	VDD	VDD	VDD	VDD	VDD	VDD
	(Note10)4	O	DO1	DO1	DO1	DO1	DO1	DO1
	(Note8)5	I	SON	SON	SON	SON	SON	SON
	(Note7)6	O	TLC	TLC	TLC	TLC/VLC	VLC	VLC/TLC
	(Note8)7	I		LOP	SP2	LOP	SP2	LOP
	(Note8)8	I	PC	PC/ST1	(Note4)ST1	ST1/RS2	(Note4)RS2	RS2/PC
	(Note8)9	I	TL	TL/ST2	(Note5)ST2	ST2/RS1	(Note5)RS1	RS1/TL
	10	—	SG	SG	SG	SG	SG	SG
	11	—	P15R	P15R	P15R	P15R	P15R	P15R
	12	I	TLA	(Note6) TLA/TLA	(Note6)	(Note6)TLA/TC	TC	TC/TLA
	13	—	COM	COM	COM	COM	COM	COM
	(Note8)14	I	RES	RES	RES	RES	RES	RES
	15	I	EMG	EMG	EMG	EMG	EMG	EMG
	16	I	LSP	LSP	LSP	LSP/—		— /LSP
	17	I	LSN	LSN	LSN	LSN/—		— /LSN
	(Note7)18	O	ALM	ALM	ALM	ALM	ALM	ALM
	(Note7,9,11)19	O	ZSP	ZSP	ZSP	ZSP	ZSP	ZSP
	20	—	SG	SG	SG	SG	SG	SG

For note, refer to the next page.

Note: 1. I : Input signal, O: Output signal, -: Others (e. g. power)
2. P : Position control mode, S: Speed control mode, T: Torque control mode, P/S: Position/speed control change mode, S/T: Speed/torque control change mode, T/P: Torque/position control change mode
3. Set parameter No. 45 to use CR.
4. Set parameter No. 47 to use PC.
5. Set parameter No. 48 to use TL.
6. By setting parameters No. 43 to 48 to make TL available, TLA can be used.
7. Set parameter No. 49 to use WNG.
8. Set parameters No. 43 to 48 to change signals.
9. Set parameter No. 49 to select alarm codes. (Refer to Chapter 9.)
10. The signal of CN1A-18 is always output.
11. Set parameter No. 1 to select MBR.

(3) Symbols and signal names

Symbol	Signal Name	Symbol	Signal Name
SON	Servo on	TLC	Limiting torque
LSP	Forward rotation stroke end	VLC	Limiting speed
LSN	Reverse rotation stroke end	RD	Ready
CR	Clear	ZSP	Zero speed
SP1	Speed selection 1	INP	In position
SP2	Speed selection 2	SA	Speed reached
PC	Proportion control	ALM	Trouble
ST1	Forward rotation start	WNG	Warning
ST2	Reverse rotation start	OP	Encoder Z-phase pulse (open collector)
TL	Torque limit selection	MBR	Electromagnetic brake interlock
RES	Reset	LZ	Encoder Z-phase pulse
EMG	Forced stop	LZR	(differential line driver)
LOP	Control change	LA	Encoder A-phase pulse
VC	Analog speed command	LAR	(differential line driver)
VLA	Analog speed limit	LB	Encoder B-phase pulse
TLA	Analog torque limit	LBR	(differential line driver)
TC	Analog torque command	VDD	I/F internal power supply
RS1	Forward rotation selection	COM	Digital I/F power supply input
RS2	Reverse rotation selection	OPC	Open collector power input
PP	Forward/reverse rotation pulse train	SG	Digital I/F common
NP		P15R	DC15V power supply
PG		LG	Control common
NG		SD	Shield

3.3.2 Signal explanations

For the I/O interfaces (symbols in I/O column in the table), refer to Section 3.6.2.
In the Control Mode field of the table
P : Position control mode, S: Speed control mode, T: Torque control mode
O : Denotes that the signal may be used in the initial setting status.
Δ : Denotes that the signal may be used by setting the corresponding parameter among parameters 43 to 49.

(1) Input signals

<table>
<tr><th rowspan="2">Signal</th><th rowspan="2">Symbol</th><th rowspan="2">Connector Pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O Division</th><th colspan="3">Control Mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Servo-on</td><td>SON</td><td>CN1B
5</td><td>Ready signal input terminal.
Connect SON-SG to switch on the base circuit and make the servo amplifier ready to operate (servo on).
Disconnect SON-SG to shut off the base circuit and coast the servo motor (servo off) .
Set□□□1 in parameter No. 41 to switch this signal on (keep terminals connected) automatically in the servo amplifier.</td><td>DI-1</td><td>O</td><td>O</td><td>O</td></tr>
<tr><td>Reset</td><td>RES</td><td>CN1B
14</td><td>Alarm reset signal input terminal.
Disconnect RES-SG for more than 50ms to reset the alarm.
Some alarms cannot be deactivated by the reset signal. Refer to Section 9.2.
The base circuit is shut off while RES-SG are shorted.</td><td>DI-1</td><td>O</td><td>O</td><td>O</td></tr>
<tr><td>Forward rotation stroke end</td><td>LSP</td><td>CN1B
16</td><td rowspan="2">Forward/reverse rotation stroke end signal input terminals.
To start operation, short LSP-SG and/or LSN-SG. Open them to bring the motor to a sudden stop and make it servo-locked.
Set□□□1 in parameter No. 22 to make a slow stop.
<table><tr><th colspan="2">(Note) Input signals</th><th colspan="2">Operation</th></tr><tr><th>LSP</th><th>LSN</th><th>CCW direction</th><th>CW direction</th></tr><tr><td>1</td><td>1</td><td>O</td><td>O</td></tr><tr><td>0</td><td>1</td><td></td><td>O</td></tr><tr><td>1</td><td>0</td><td>O</td><td></td></tr><tr><td>0</td><td>0</td><td></td><td></td></tr></table>Note. 0: OFF (LSP/LSN-SG open)
1: ON (LSP/LSN-SG shorted)
Set parameter No. 41 as indicated below to switch on the signals (keep terminals connected) automatically in the servo amplifier:
<table><tr><th>Parameter No.41</th><th>Automatic ON</th></tr><tr><td>□□1□</td><td>LSP</td></tr><tr><td>□1□□</td><td>LSN</td></tr></table></td><td rowspan="2">DI-1</td><td rowspan="2">O</td><td rowspan="2">O</td><td rowspan="2"></td></tr>
<tr><td>Reverse rotation stroke end</td><td>LSN</td><td>CN1B
17</td></tr>
</table>

<table>
<tr><th rowspan="2">Signal</th><th rowspan="2">Symbol</th><th rowspan="2">Connector Pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O Division</th><th colspan="3">Control Mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Torque limit</td><td>TL</td><td>CN1B
9</td><td>Torque limit selection input device.
Short TL-SG to make the analog torque limit valid.
For details, refer to (2), section 3.4.1.</td><td>DI-1</td><td>○</td><td>△</td><td></td></tr>
<tr><td>Forward rotation start</td><td>ST1</td><td>CN1B
8</td><td rowspan="2">Used to start the servo motor in any of the following directions:
<table><tr><th colspan="2">(Note) Input signals</th><th rowspan="2">Servo Motor Starting Direction</th></tr><tr><th>ST2</th><th>ST1</th></tr><tr><td>0</td><td>0</td><td>Stop (servo lock)</td></tr><tr><td>0</td><td>1</td><td>CCW</td></tr><tr><td>1</td><td>0</td><td>CW</td></tr><tr><td>1</td><td>1</td><td>Stop (servo lock)</td></tr></table>Note.0: OFF (ST1/ST2-SG open)
1: ON (ST1/ST2-SG shorted)
If both ST1 and ST2 are switched on or off during operation, the servo motor will be decelerated to a stop according to the parameter No. 12 setting and servo-locked. When the analog speed command (VC) is 0V, starting the servo motor will not generate servo lock torque.</td><td rowspan="2">DI-1</td><td rowspan="2"></td><td rowspan="2">○</td><td rowspan="2"></td></tr>
<tr><td>Reverse rotation start</td><td>ST2</td><td>CN1B
9</td></tr>
<tr><td>Forward rotation selection</td><td>RS1</td><td>CN1B
9</td><td rowspan="2">Used to select any of the following servo motor torque generation directions:
<table><tr><th colspan="2">(Note) Input signals</th><th rowspan="2">Torque Generation Direction</th><th rowspan="2">Rotation Direction</th></tr><tr><th>RS2</th><th>RS1</th></tr><tr><td>0</td><td>0</td><td>No torque</td><td>Stop</td></tr><tr><td>0</td><td>1</td><td>Forward rotation in driving mode / reverse rotation in regenerative mode</td><td>CCW</td></tr><tr><td>1</td><td>0</td><td>Reverse rotation in driving mode / forward rotation in regenerative mode</td><td>CW</td></tr><tr><td>1</td><td>1</td><td>No torque</td><td>Stop</td></tr></table>Note.0: OFF (RS1/RS2-SG open)
1: ON (RS1/RS2-SG shorted)</td><td rowspan="2">DI-1</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">○</td></tr>
<tr><td>Reverse rotation selection</td><td>RS2</td><td>CN1B
8</td></tr>
</table>

<table>
<tr><th rowspan="2">Signal</th><th rowspan="2">Symbol</th><th rowspan="2">Connector Pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O Division</th><th colspan="3">Control Mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Speed selection 1</td><td>SP1</td><td>CN1A
8</td><td rowspan="2"><Speed control mode>
Used to select the command speed for operation.
<table><tr><th colspan="2">(Note) Input signals</th><th rowspan="2">Speed Command</th></tr><tr><th>SP2</th><th>SP1</th></tr><tr><td>0</td><td>0</td><td>Analog speed command (VC)</td></tr><tr><td>0</td><td>1</td><td>Internal speed command 1
(parameter No. 8)</td></tr><tr><td>1</td><td>0</td><td>Internal speed command 2
(parameter No. 9)</td></tr><tr><td>1</td><td>1</td><td>Internal speed command 3
(parameter No. 10)</td></tr></table>Note.0:OFF (SP1/SP2-SG open)
1:ON (SP1/SP2-SG shorted)
<Torque control mode>
Used to select the limit speed for operation.
<table><tr><th colspan="2">(Note) Input signals</th><th rowspan="2">Speed Limit</th></tr><tr><th>SP2</th><th>SP1</th></tr><tr><td>0</td><td>0</td><td>Analog speed limit (VLA)</td></tr><tr><td>0</td><td>1</td><td>Internal speed limit 1 (parameter No. 8)</td></tr><tr><td>1</td><td>0</td><td>Internal speed limit 2 (parameter No. 9)</td></tr><tr><td>1</td><td>1</td><td>Internal speed limit 3 (parameter No. 10)</td></tr></table></td><td rowspan="2">DI-1</td><td rowspan="2"></td><td rowspan="2">○</td><td rowspan="2">○</td></tr>
<tr><td>Speed selection 2</td><td>SP2</td><td>CN1B
7</td></tr>
<tr><td colspan="4">Note.0:OFF (SP1/SP2-SG open)
1:ON (SP1/SP2-SG shorted)
<Position/speed, speed/torque, torque/position control change mode>

As CN1B-7 acts as a control change signal, the speed selected when the speed or torque control mode is selected is as follows:
· When speed control mode is selected
<table><tr><th>(Note) SP1</th><th>Speed Command</th></tr><tr><td>0</td><td>Analog speed command (VC)</td></tr><tr><td>1</td><td>Internal speed command 1 (parameter No. 8)</td></tr></table>Note. 0: OFF (SP1-SG open)
1: ON (SP1-SG shorted)
· When torque control mode is selected
<table><tr><th>(Note) SP1</th><th>Speed Limit</th></tr><tr><td>0</td><td>Analog speed limit (VLA)</td></tr><tr><td>1</td><td>Internal speed limit 1 (parameter No. 8)</td></tr></table>Note. 0: OFF (SP1-SG open)
1: ON (SP1-SG shorted)</td></tr>
</table>

<table>
<tr><th rowspan="2">Signal</th><th rowspan="2">Symbol</th><th rowspan="2">Connector Pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O Division</th><th colspan="3">Control Mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Proportion control</td><td>PC</td><td>CN1B
8</td><td>Connect PC-SG to switch the speed amplifier from the proportional integral type to the proportional type.
If the servo motor at a stop is rotated even one pulse due to any external factor, it generates torque to compensate for a position shift. When the servo motor shaft is to be locked mechanically after positioning completion (stop), switching on the proportion control signal (PC) upon positioning completion will suppress the unnecessary torque generated to compensate for a position shift.
When the shaft is to be locked for a long time, switch on the proportion control signal and torque control signal (TL) at the same time to make the torque less than the rated by the analog torque limit.</td><td>DI-1</td><td>○</td><td>△</td><td></td></tr>
<tr><td>Forced stop</td><td>EMG</td><td>CN1B
15</td><td>Disconnect EMG-SG to bring the servo motor to a forced stop state, in which the servo is switched off and the dynamic brake is operated.
Connect EMG-SG in the forced stop state to reset that state.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Clear</td><td>CR</td><td>CN1A
8</td><td>Connect CR-SG to clear the position control counter droop pulses on the leading edge of the signal. The pulse width should be 10ms or more.
When the parameter No. 42 setting is □□1□, the pulses are always cleared while CR-SG are connected.</td><td>DI-1</td><td>○</td><td></td><td></td></tr>
<tr><td>Control change</td><td>LOP</td><td>CN1B
7</td><td><Position/speed control change mode>
Used to select the control mode in the position/speed control change mode.
<table><tr><th>(Note) LOP</th><th>Control Mode</th></tr><tr><td>0</td><td>Position</td></tr><tr><td>1</td><td>Speed</td></tr></table>Note.0: OFF (LOP-SG open)
1: ON (LOP-SG shorted)
<Speed/torque control change mode>
Used to select the control mode in the speed/torque control change mode.
<table><tr><th>(Note) LOP</th><th>Control Mode</th></tr><tr><td>0</td><td>Speed</td></tr><tr><td>1</td><td>Torque</td></tr></table>Note.0: OFF (LOP-SG open)
1: ON (LOP-SG shorted)
<Torque/position control mode>
Used to select the control mode in the torque/position control change mode.
<table><tr><th>(Note) LOP</th><th>Control Mode</th></tr><tr><td>0</td><td>Torque</td></tr><tr><td>1</td><td>Position</td></tr></table>Note.0: OFF (LOP-SG open)
1: ON (LOP-SG shorted)</td><td>DI-1</td><td colspan="3">Refer to Functions/ Applications.</td></tr>
</table>

Signal	Symbol	Connector Pin No.	Functions/Applications	I/O Division	Control Mode P	S	T
Analog torque limit	TLA	CN1B 12	To use this signal in the speed control mode, set any of parameters No. 43 to 48 to make TL available. When the analog torque limit (TLA) is valid, torque is limited in the full servo motor output torque range. Apply 0 to +10 VDC across TLA-LG. Connect the positive terminal of the power supply to TLA. Maximum torque is generated at +10 V. (Refer to (2) in Section 3.4.1.)	Analog input	○	△	
Analog torque command	TC		Used to control torque in the full servo motor output torque range. Apply 0 to ±8VDC across TC-LG. Maximum torque is generated at ±8V. (Refer to (1) in Section 3.4.3.) The torque generated at ±8V input can be changed using parameter No. 26.	Analog input			○
Analog speed command	VC	CN1B 2	Apply 0 to ±10VDC across VC-LG. Speed set in parameter No. 25 is provided at ±10V. (Refer to (1) in Section 3.4.2.)	Analog input		○	
Analog speed limit	VLA		Apply 0 to ±10VDC across VLA-LG. Speed set in parameter No. 25 is provided at ±10V. (Refer to (3) in Section 3.4.3.)	Analog input			○
Forward rotation pulse train Reverse rotation pulse train	PP NP PG NG	CN1A 3 CN1A 2 CN1A 13 CN1A 12	Used to enter a command pulse train. · In the open collector system (max. input frequency 200kpps): Forward rotation pulse train across PP-SG Reverse rotation pulse train across NP-SG · In the differential receiver system (max. input frequency 500kpps): Forward rotation pulse train across PG-PP Reverse rotation pulse train across NG-NP The command pulse train form can be changed using parameter No. 21.	DI－2	○		

(2) Output signals

Signal	Symbol	Connector Pin No.	Functions/Applications	I/O Division	Control Mode		
					P	S	T
Trouble	ALM	CN1B 18	ALM-SG are disconnected when power is switched off or the protective circuit is activated to shut off the base circuit. Without alarm, ALM-SG are connected within 1 after power on.	DO-1	○	○	○
Ready	RD	CN1A 19	RD-SG are connected when the servo is switched on and the servo amplifier is ready to operate.	DO-1	○	○	○
In position	INP	CN1A 18	INP-SG are connected when the number of droop pulses is in the preset in-position range. The in-position range can be changed using parameter No. 5. When the in-position range is increased, INP-SG may be kept connected during low-speed rotation.	DO-1	○		
Speed reached	SA		SA-SG are connected when the servo motor speed has nearly reached the preset speed. When the preset speed is 50r/min or less, SA-SG are kept connected.	DO-1		○	
Limiting speed	VLC	CN1B 6	VLC-SG are connected when speed reaches the value set to any of the internal speed limits 1 to 3 (parameters No. 8 to 10) or the analog speed limit (VLA) in the torque control mode. They are disconnected when the servo-on signal (SON) switches off.	DO-1			○
Limiting torque	TLC	CN1B 6	TLC-SG are connected when the torque generated reaches the value set to the internal torque limit 1 (parameter No. 28) or analog torque limit (TLA). They are disconnected when the servo-on signal (SON) switches off.	DO-1	○	○	
Zero speed	ZSP	CN1B 19	ZSP-SG are connected when the servo motor speed is zero speed (50r/min) or less. Zero speed can be changed using parameter No. 24.	DO-1	○	○	○
Electromagnetic brake interlock	MBR	(CN1B 19)	Set□□1□ in parameter No. 1 to use this parameter. Note that ZSP will be unusable. In the servo-off or alarm status, MBR-SG are disconnected. When an alarm occurs, they are disconnected independently of the base circuit status.	DO-1	△	△	△
Warning	WNG		To use this signal, assign the connector pin for output using parameter No. 49. The old signal before assignment will be unusable. When warning has occurred, WNG-SG are connected. When there is no warning, WNG-SG are disconnected within 1 second after power-on.	DO-1	△	△	△

<table>
<tr><th>Signal</th><th>Symbol</th><th>Connector Pin No.</th><th>Functions/Applications</th><th>I/O Division</th><th colspan="3">Control Mode</th></tr>
<tr><th></th><th></th><th></th><th></th><th></th><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Alarm code</td><td></td><td>CN1A
19
CN1A
18
CN1B
19</td><td>To use this signal, set □□□1 in parameter No. 49.
This signal is output when an alarm occurs. When there is no alarm, respective ordinary signals (RD, INP, SA, ZSP) are output.
Alarm codes and alarm names are listed below:
<table>
<tr><th colspan="3">(Note) Alarm Code</th><th rowspan="2">Alarm Display</th><th rowspan="2">Name</th></tr>
<tr><th>CN1B 19 Pin</th><th>CN1A 18 Pin</th><th>CN1A 19 Pin</th></tr>
<tr><td rowspan="9">0</td><td rowspan="9">0</td><td rowspan="9">0</td><td>8888</td><td>Watchdog</td></tr>
<tr><td>A. 11</td><td>Board error 1</td></tr>
<tr><td>A. 12</td><td>Memory error 1</td></tr>
<tr><td>A. 13</td><td>Clock error</td></tr>
<tr><td>A. 15</td><td>Memory error 2</td></tr>
<tr><td>A. 17</td><td>Board error 2</td></tr>
<tr><td>A. 18</td><td>Board error 3</td></tr>
<tr><td>A. 37</td><td>Parameter error</td></tr>
<tr><td>A. 8E</td><td>RS-232C error</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>A. 33</td><td>Overvoltage</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>A. 10</td><td>Undervoltage</td></tr>
<tr><td rowspan="2">0</td><td rowspan="2">1</td><td rowspan="2">1</td><td>A. 50</td><td>Overload 1</td></tr>
<tr><td>A. 51</td><td>Overload 2</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">0</td><td rowspan="2">0</td><td>A. 24</td><td>Motor output ground fault</td></tr>
<tr><td>A. 32</td><td>Overcurrent</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">0</td><td rowspan="3">1</td><td>A. 31</td><td>Overspeed</td></tr>
<tr><td>A. 35</td><td>Command pulse frequency alarm</td></tr>
<tr><td>A. 52</td><td>Error excessive</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">1</td><td rowspan="2">0</td><td>A. 16</td><td>Encoder error 1</td></tr>
<tr><td>A. 20</td><td>Encoder error 2</td></tr>
</table>
Note. 0: OFF (Pin-SG open)
1: ON (Pin-SG shorted)</td><td>DO-1</td><td>Δ</td><td>Δ</td><td>Δ</td></tr>
</table>

Signal	Symbol	Connector Pin No.	Functions/Applications	I/O Division	Control Mode		
					P	S	T
Encoder Z-phase pulse (Open collector)	OP	CN1A 14	Outputs the zero-point signal of the encoder. One pulse is output per servo motor revolution. OP and LG are connected when the zero-point position is reached. (Negative logic) The maximum pulse width is about 400μs. For zeroing using this pulse, set the creep speed to 100r/min. or less.	DO-2	O	O	O
Encoder A-phase pulse (Differential line driver)	LA LAR	CN1A 6 CN1A 16	Outputs pulses per servo motor revolution set in parameter No. 27 in the differential line driver system. The encoder B-phase pulse lags the encoder A-phase pulse by a phase angle of π/2.	DO-2	O	O	O
Encoder B-phase pulse (Differential line driver)	LB LBR	CN1A 7 CN1A 17					
Encoder Z-phase pulse (Differential line driver)	LZ LZR	CN1A 5 CN1A 15	The same signal as OP is output in the differential line driver system.	DO-2	O	O	O

(3) Power supply

Signal	Symbol	Connector Pin No.	Functions/Applications	I/O Division	Control Mode		
					P	S	T
I/F internal power supply	VDD	CN1B 3	Used to output 24VDC for input interface. Connected with P24L inside the servo amplifier.		○	○	○
Digital I/F power supply input	COM	CN1A 9 CN1B 13	Used to input 24VDC for input interface. Connect the positive terminal of the 24VDC external power supply. 24VDC±10%		○	○	○
Open collector power input	OPC	CN1A 11	When inputting a pulse train in the open collector system, supply this terminal with the positive (+) power of 24VDC.		○	○	○
Digital I/F common	SG	CN1A 10 20 CN1B 10 20	Common terminal for input signals such as SON and EMG. Pins are connected internally. Internally connected with LG.		○	○	○
DC15V power supply	P15R	CN1A 4 CN1B 11	Outputs 15VDC to across P15R-LG. Available as power for TC, TLA, VC, VLA. Permissible current: 30mA		○	○	○
Control common	LG	CN1A 1 CN1B 1 CN3 1 3 5 11 13 15	Common terminal for TLA, TC, VC, VLA, FPA, FPB, OP and P15R. Pins are connected internally.		○	○	○
Shield	SD	Plate	Connect the external conductor of the shield cable.		○	○	○

3.4 Detailed Description of the Signals

3.4.1 Position control mode

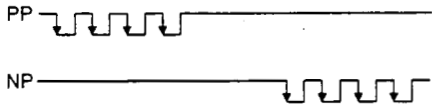
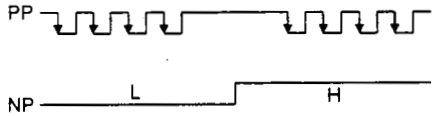
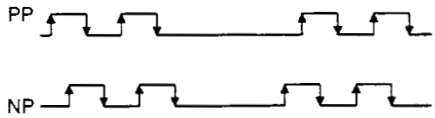
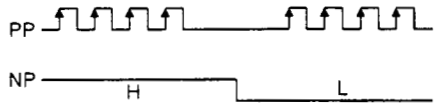
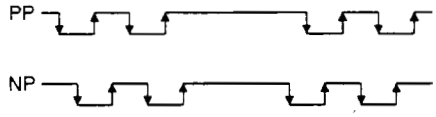
(1) Pulse train input

(a) Input pulse waveform selection

Encoder pulses may be input in any of three different forms, for which positive or negative logic can be chosen. Set the command pulse train form in parameter No. 21.

Arrow ⌐⌐ or ⌐⌐ in the table indicates the timing of importing a pulse train.

A- and B-phase pulse trains are imported after they have been multiplied by 4.

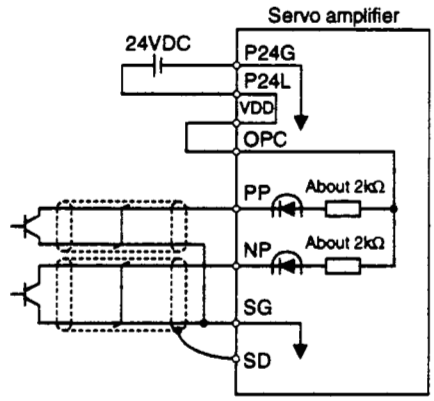
	Pulse Train Form	Forward Rotation	Reverse Rotation	(Note) Parameter No. 21 (Command pulse train)
Negative logic	Forward rotation pulse train Reverse rotation pulse train			0010
	Pulse train + sign			0011
	A-phase pulse train B-phase pulse train			0012
Positive logic	Forward rotation pulse train Reverse rotation pulse train			0000
	Pulse train + sign			0001
	A-phase pulse train B-phase pulse train			0002

Note: Set "0000" when using the AD75P in the programmable controller.

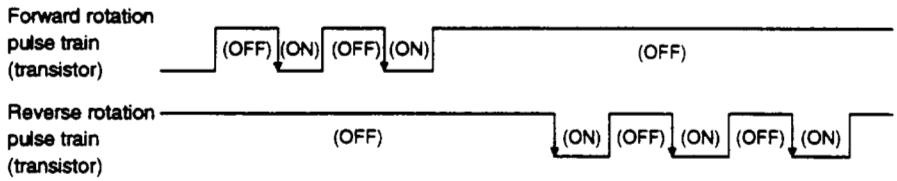
(b) Connections and waveforms

1) Open collector system

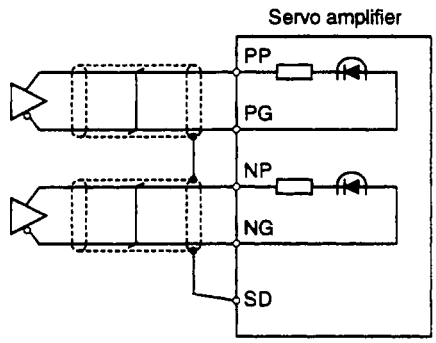
Connect as shown below:



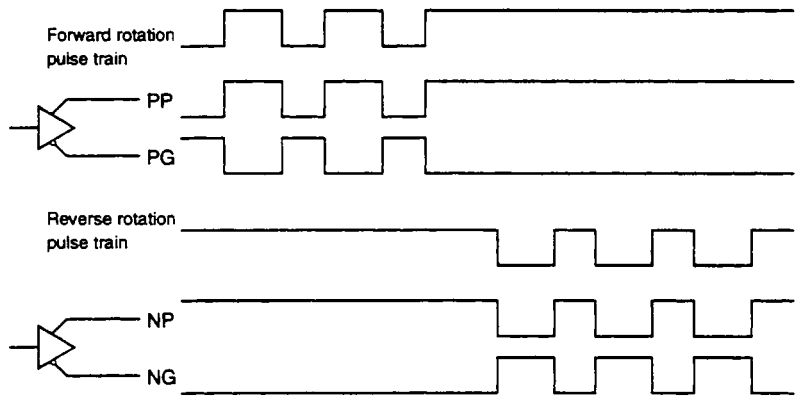
The explanation assumes that the input waveform has been set to the negative logic and forward and reverse rotation pulse trains (parameter No.21 has been set to 0010). The waveforms in the table in (a), (1) of this section are voltage waveforms of PP and NP based on SG. Their relationships with transistor ON/OFF are as follows:



2) Differential line driver system
Connect as shown below:



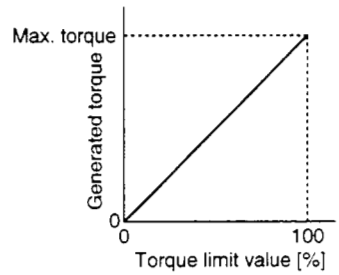
The explanation assumes that the input waveform has been set to the negative logic and forward and reverse rotation pulse trains (parameter No.21 has been set to 0010).
For the differential line driver, the waveforms in the table in (a), (1) of this section are as follows. The waveforms of PP, PG, NP and NG are based on that of the ground of the differential line driver.



(2) Torque limit

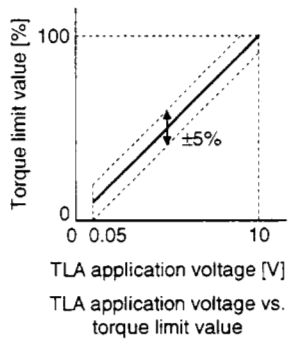
(a) Torque limit and generated torque

By setting parameter No. 28 (internal torque limit 1), torque is always limited to the maximum value during operation. A relationship between the limit value and servo motor-generated torque is shown below.

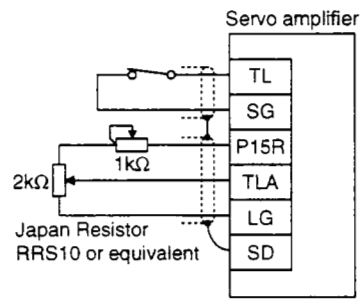


A relationship between the applied voltage of the analog torque limit (TLA) and the torque limit value of the servo motor is shown below. Generated torque limit values will vary about 5% relative to the voltage depending on products.

At the voltage of less than 0.05V, generated torque may vary as it may not be limited sufficiently. Therefore, use this function at the voltage of 0.05V or more.



TLA application voltage vs. torque limit value



(b) Torque limit value selection

Choose the torque limit made valid by the internal torque limit value 1 (parameter No. 28) using the external torque limit selection (TL) or the torque limit made valid by the analog torque limit (TLA) as indicated below:

(Note) TL	Torque Limit Value Made Valid	
	If TLA > Parameter No. 28	If TLA < Parameter No. 28
0	Internal torque limit value 1 (parameter No. 28)	
1	Internal torque limit value 1 (parameter No. 28)	Analog torque limit (TLA)

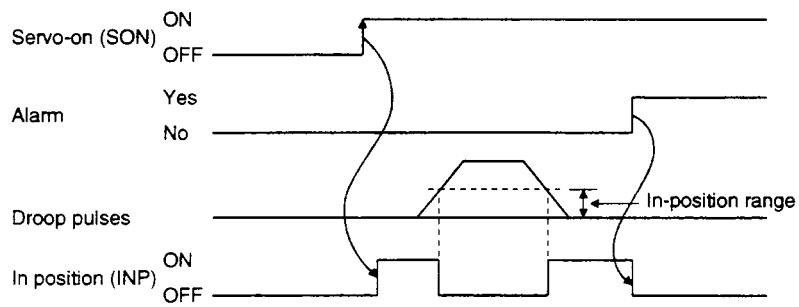
Note. 0 : TLA-SG off (open)
1 : TLA-SG on (short)

(c) Limiting torque (TLC)

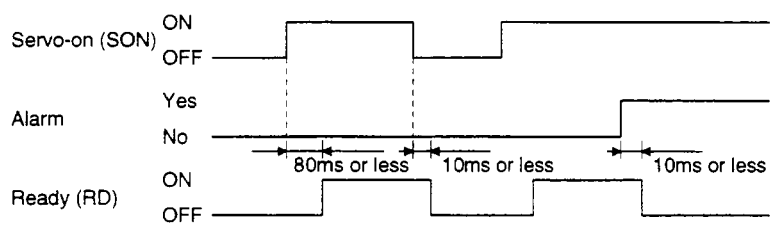
TLC-SG are connected when the torque generated by the servo motor reaches the torque set to internal torque limit value 1 or analog torque limit.

(3) In-position (INP)

PF-SG are connected when the number of droop pulses in the deviation counter falls within the preset in-position range (parameter No. 5). INP-SG may remain connected when low-speed operation is performed with a large value set as the in-position range.



(4) Ready (RD)

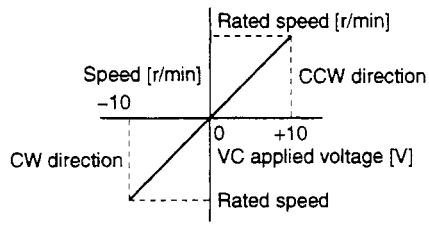


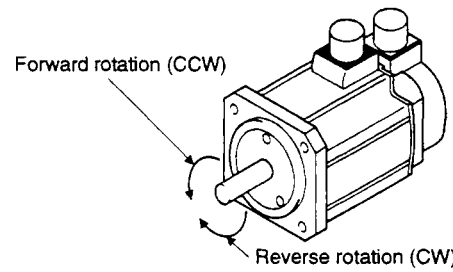
3.4.2 Speed control mode

(1) Speed setting

(a) Speed command and speed

The servo motor is run at the speeds set in the parameters or at the speed set in the applied voltage of the analog speed command (VC). A relationship between the analog speed command (VC) applied voltage and the servo motor speed is shown below:



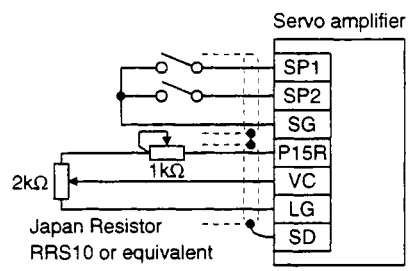


The following table indicates the rotation direction according to forward rotation start (ST1) and reverse rotation start (ST2) combination:

(Note) External Input Signals		Rotation Direction			
ST2	ST1	Analog Speed Command (VC)			Internal Speed Commands
		+ Polarity	0V	- Polarity	
0	0	Stop (Servo lock)	Stop (Servo lock)	Stop (Servo lock)	Stop (Servo lock)
0	1	CCW	Stop (No servo lock)	CW	CCW
1	0	CW		CCW	CW
1	1	Stop (Servo lock)	Stop (Servo lock)	Stop (Servo lock)	Stop (Servo lock)

Note. 0 : ST1/ST2-SG off (open)
1 : ST1/ST2-SG on (short)

Generally, make connection as shown below:



(b) Speed selection 1 (SP1), speed selection 2 (SP2) and speed command value

Choose any of the speed settings made by the internal speed commands 1 to 3 using speed selection 1 (SP1) and speed selection 2 (SP2) or the speed setting made by the analog speed command (VC).

(Note) External Input Signals		Speed Command Value
SP2	SP1	
0	0	Analog speed command (VC)
0	1	Internal speed command 1 (parameter No. 8)
1	0	Internal speed command 2 (parameter No. 9)
1	1	Internal speed command 3 (parameter No. 10)

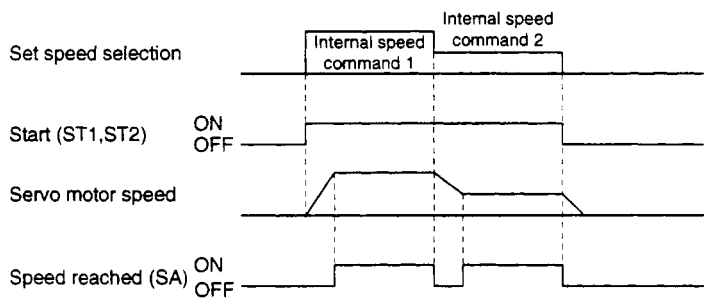
Note. 0 : SP1/SP2-SG off (open)
1 : SP1/SP2-SG on (short)

The speed may be changed during rotation. In this case, the values set in parameters No. 11 and 12 are used for acceleration/deceleration.

When the speed has been specified under any internal speed command, it does not vary due to the ambient temperature.

(2) Speed reached (SA)

SA-SG are connected when the servo motor speed nearly reaches the speed set to the internal speed command or analog speed command.



(3) Torque limit

As in Section 3.4.1 (2).

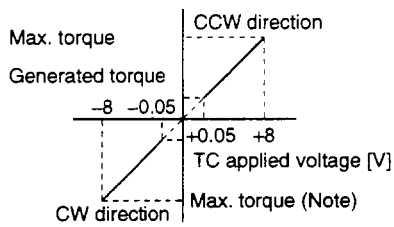
3.4.3 Torque control mode

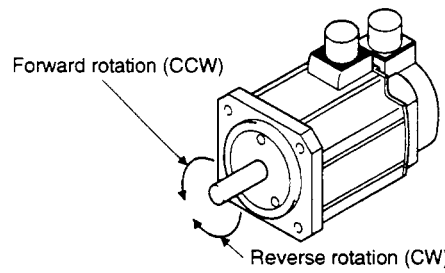
(1) Torque control

(a) Torque command and generated torque

A relationship between the applied voltage of the analog torque command (TC) and the torque generated by the servo motor is shown below.

The maximum torque is generated at ±8V. Note that the torque generated at ±8V input can be changed with parameter No. 26.





Generated torque limit values will vary about 5% relative to the voltage depending on products.

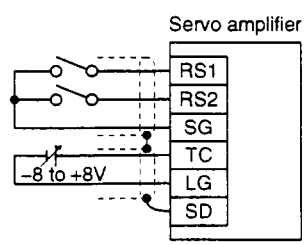
Generated torque may vary at the voltage of −0.05V to +0.05V.

The following table indicates the torque generation directions determined by the forward rotation selection (RS1) and reverse rotation selection (RS2) when the analog torque command (TC) is used.

(Note) External Input Signals		Rotation Direction		
RS2	RS1	Torque control Command (TC)		
		+ Polarity	0V	− Polarity
0	0	No torque	No torque	No torque
0	1	CCW (reverse rotation in driving mode/forward rotation in regenerative mode)		CW (forward rotation in driving mode/reverse rotation in regenerative mode)
1	0	CW (forward rotation in driving mode/reverse rotation in regenerative mode)		CCW (reverse rotation in driving mode/forward rotation in regenerative mode)
1	1	No torque		No torque

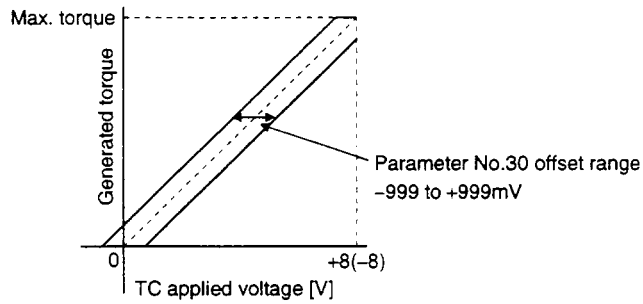
Note. 0: RS1/RS2-SG off (open)
1: RS1/RS2-SG on (short)

Generally, make connection as shown below:



(b) Analog torque command offset

Using parameter No. 30, the offset voltage of -999 to +999mV can be added to the TC applied voltage as shown below.



(2) Torque limit

By setting parameter No. 28 (internal torque limit 1), torque is always limited to the maximum value during operation. A relationship between limit value and servo motor-generated torque is as in (2) in section 3.4.1. Note that the analog torque limit (TLA) is unavailable.

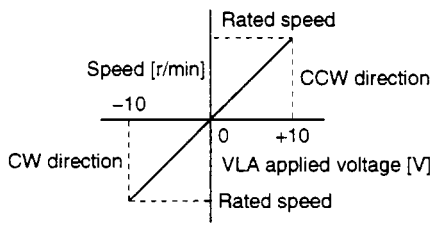
(3) Speed limit

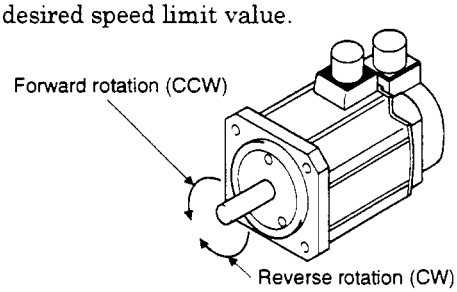
(a) Speed limit value and speed

The speed is limited to the values set in parameters No. 8 to 10 (internal speed limits 1 to 3) or the value set in the applied voltage of the analog speed limit (VLA).

A relationship between the analog speed limit (VLA) applied voltage and the servo motor speed is shown below.

When the motor speed reaches the speed limit value, torque control may become unstable. Make the set value more than 100r/m smaller than the desired speed limit value.



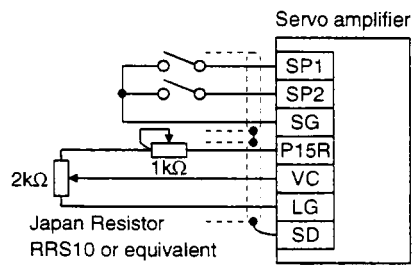


The following table indicates the limit direction according to forward rotation selection (RS1) and reverse rotation selection (RS2) combination:

(Note) External Input Signals		Speed Limit Direction		
RS1	RS2	Analog Speed Limit (VLA)		Internal Speed Commands
		+ Polarity	− Polarity	
1	0	CCW	CW	CCW
0	1	CW	CCW	CW

Note. 0: RS1/RS2-SG off (open)
1: RS1/RS2-SG on (short)

Generally, make connection as shown below:



(b) Speed selection 1 (SP1)/speed selection 2 (SP2) and speed command values

Choose any of the speed settings made by the internal speed limits 1 to 3 using speed selection 1 (SP1) and speed selection 2 (SP2) or the speed setting made by the speed limit command (VLA).

(Note) External Input Signals		Speed Command Value
SP2	SP1	
0	0	Speed limit command (VLA)
0	1	Parameter No. 8
1	0	Parameter No. 9
1	1	Parameter No. 10

Note. 0: SP1/SP2-SG off (open)
1: SP1/SP2-SG on (short)

When the internal speed commands 1 to 3 are used to command the speed, the speed does not vary with the ambient temperature.

(c) Limiting speed (VLC)

TLC-SG are connected when the servo motor speed reaches the limit speed set to any of the internal speed limits 1 to 3 or analog speed limit.

3.4.4 Position/speed control change mode

Set 0001 in parameter No. 0 to switch to the position/speed control change mode. This function is not available in the absolute position detection system.

(1) Control change (LOP)

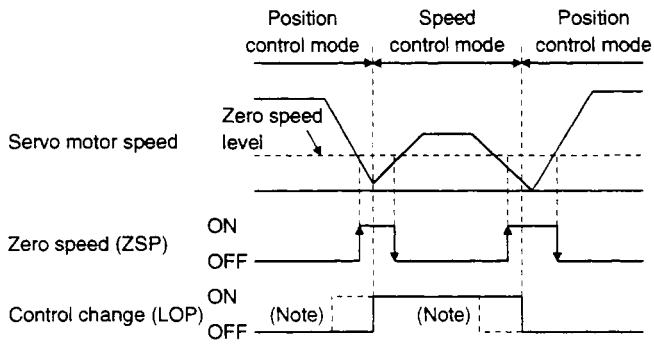
Use control change (LOP) to switch between the position control mode and the speed control mode from an external contact. Relationships between LOP-SG status and control modes are indicated below:

(Note) LOP	Servo Control Mode
0	Position control mode
1	Speed control mode

Note. 0: LOP-SG off (open)
1: LOP-SG on (short)

The control mode may be changed in the zero-speed status. To ensure safety, change control after the servo motor has stopped. When position control mode is changed to speed control mode, droop pulses are reset.

If the signal has been switched on-off at the speed higher than the zero speed and the speed is then reduced to the zero speed or less, the control mode cannot be changed. A change timing chart is shown below:



Note: When ZSP is not on, control cannot be changed if LOP is switched on-off.
If ZSP switches on after that, control cannot not be changed.

(2) Torque limit in position control mode

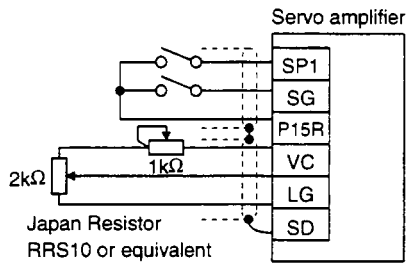
As in Section 3.4.1 (2).

(3) Speed setting in speed control mode

(a) Speed command and speed

The servo motor is run at the speed set in parameter No. 8 (internal speed command 1) or at the speed set in the applied voltage of the analog speed command (VC). A relationship between analog speed command (VC) applied voltage and servo motor speed and the rotation directions determined by the forward rotation start signal (ST1) and reverse rotation start signal (ST2) are as in (a), (1) in section 3.4.2.

Generally, make connection as shown below:



When a precision speed command is required, refer to (a), (1) in section 3.4.2

(b) Speed selection 1 (SP1) and speed command value

Use speed selection 1 (SP1) to select between the speed set by the internal speed command 1 and the speed set by the analog speed command (VC) as indicated in the following table:

(Note) External Input Signals	Speed Command Value
SP1	
0	Analog speed command (VC)
1	Internal speed command 1 (parameter No. 8)

Note. 0: SP1-SG off (open)
1: SP1-SG on (short)

The speed may also be changed during rotation. In this case, it is increased or decreased according to the value set in parameter No. 11 or 12.

When the internal speed command 1 is used to command the speed, the speed does not vary with the ambient temperature.

(c) Speed reached (SA)

As in Section 3.4.2 (2).

3.4.5 Speed/torque control change mode

Set 0003 in parameter No. 0 to switch to the speed/torque control change mode.

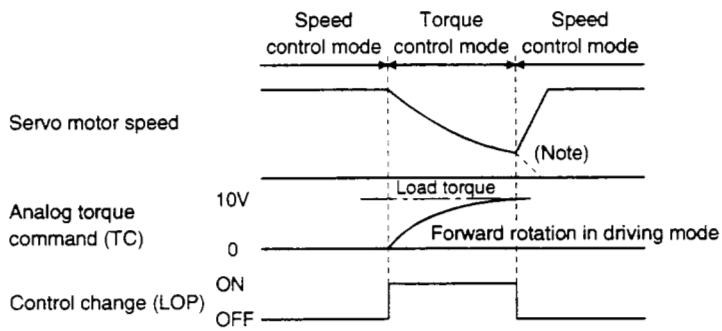
(1) Control change (LOP)

Use control change (LOP) to switch between the speed control mode and the torque control mode from an external contact. Relationships between LOP-SG status and control modes are indicated below:

(Note) LOP	Servo Control Mode
0	Speed control mode
1	Torque control mode

Note. 0: LOP-SG off (open)
1: LOP-SG on (short)

The control mode may be changed at any time. A change timing chart is shown below:



Note: When the start signal (ST1 · ST2) is switched off as soon as the mode is changed to speed control, the servo motor comes to a stop according to the deceleration time constant.

(2) Speed setting in speed control mode

As in Section 3.4.2 (1).

(3) Torque limit in speed control mode

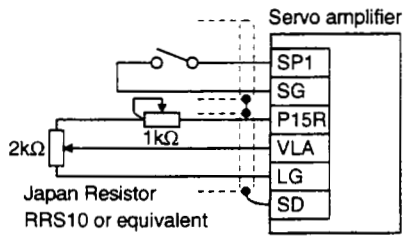
As in Section 3.4.1 (2).

(4) Speed limit in torque control mode

(a) Speed limit value and speed

The speed is limited to the limit value set in parameter No. 8 (internal speed limit 1) or the value set in the applied voltage of the analog speed limit (VLA). A relationship between the analog speed limit (VLA) applied voltage and the servo motor speed is as in (a), (3) in section 3.4.3.

Generally, make connection as shown below:



When a precision speed command is required, refer to (a), (3) in section 3.4.3.

(b) Speed selection 1 (SP1) and speed limit value

Use speed selection 1 (SP1) to select between the speed set by the internal speed command 1 and the speed set by the analog speed limit (VLA) as indicated in the following table:

(Note) External Input Signals	Speed Command Value
SP1	
0	Analog speed limit (VLA)
1	Internal speed limit 1 (parameter No. 8)

Note.0: SP1-SG off (open)
1: SP1-SG on (short)

When the internal speed limit 1 is used to command the speed, the speed does not vary with the ambient temperature.

(c) Limiting speed (VLC)

As in (c), (3) in section 3.4.3.

(5) Torque control in torque control mode

As in Section 3.4.3 (1).

(6) Torque limit in torque control mode

As in Section 3.4.3 (2).

3.4.6 Torque/position control change mode

Set 0005 in parameter No. 0 to switch to the torque/position control change mode.

(1) Control change (LOP)

Use control change (LOP) to switch between the torque control mode and the position control mode from an external contact. Relationships between LOP-SG status and control modes are indicated below:

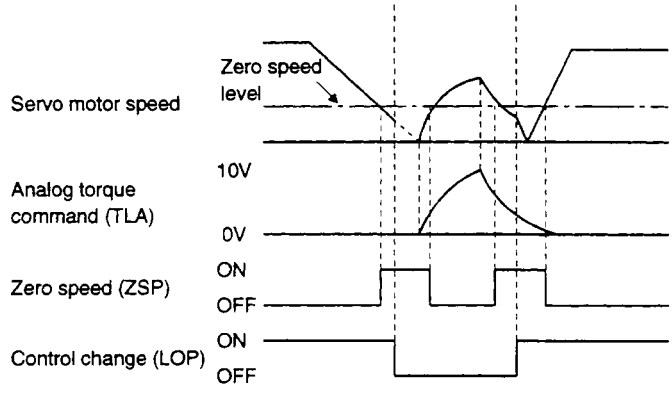
(Note) LOP	Servo Control Mode
0	Torque control mode
1	Position control mode

Note. 0: LOP-SG off (open)
1: LOP-SG on (short)

The control mode may be changed in the zero-speed status.

To ensure safety, change control after the servo motor has stopped. When position control mode is changed to torque control mode, droop pulses are reset.

If the signal has been switched on-off at the speed higher than the zero speed and the speed is then reduced to the zero speed or less, the control mode cannot be changed. A change timing chart is shown below:



(2) Speed limit in torque control mode

As in Section 3.4.3 (3).

(3) Torque control in torque control mode

As in Section 3.4.3 (1).

(4) Torque limit in torque control mode

As in Section 3.4.3 (2).

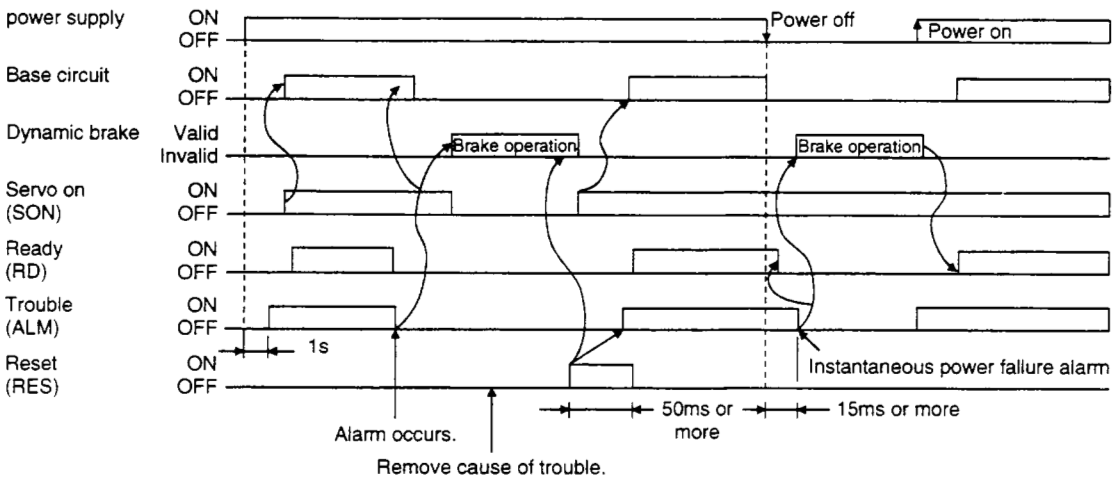
(5) Torque limit in position control mode

As in Section 3.4.1 (2).

3.5 Alarm Occurrence Timing Chart

> **⚠ CAUTION**
>
> • When an alarm has occurred, remove its cause, make sure that the operation signal is not being input, ensure safety, and reset the alarm before restarting operation.

When an alarm occurs in the servo amplifier, the base circuit is shut off and the servo motor is coated to a stop. Switch off the main circuit power supply in the external sequence. To reset the alarm, switch the control circuit power supply off, then on.
However, the alarm cannot be reset unless its cause of occurrence is removed.



Precautions for alarm occurrence

1) Overcurrent, overload 1 or overload 2

If operation is repeated by switching control circuit power off, then on to reset the overcurrent (A. 32), overload 1 (A. 50) or overload 2 (A. 51) alarm after its occurrence, without removing its cause, the servo amplifier and servo motor may become faulty due to temperature rise. Securely remove the cause of the alarm and also allow about 15 minutes for cooling before resuming operation.

2) Instantaneous power failure

If a power failure continues 15ms or longer, the undervoltage (A. 10) alarm will occur. If the power failure still persists for 20ms or longer, the control circuit is switched off. When the power failure is reset in this state, the alarm is reset and the servo motor will start suddenly if the servo-on signal (SON) is on. To prevent hazard, make up a sequence which will switch off the servo-on signal (SON) if an alarm occurs.

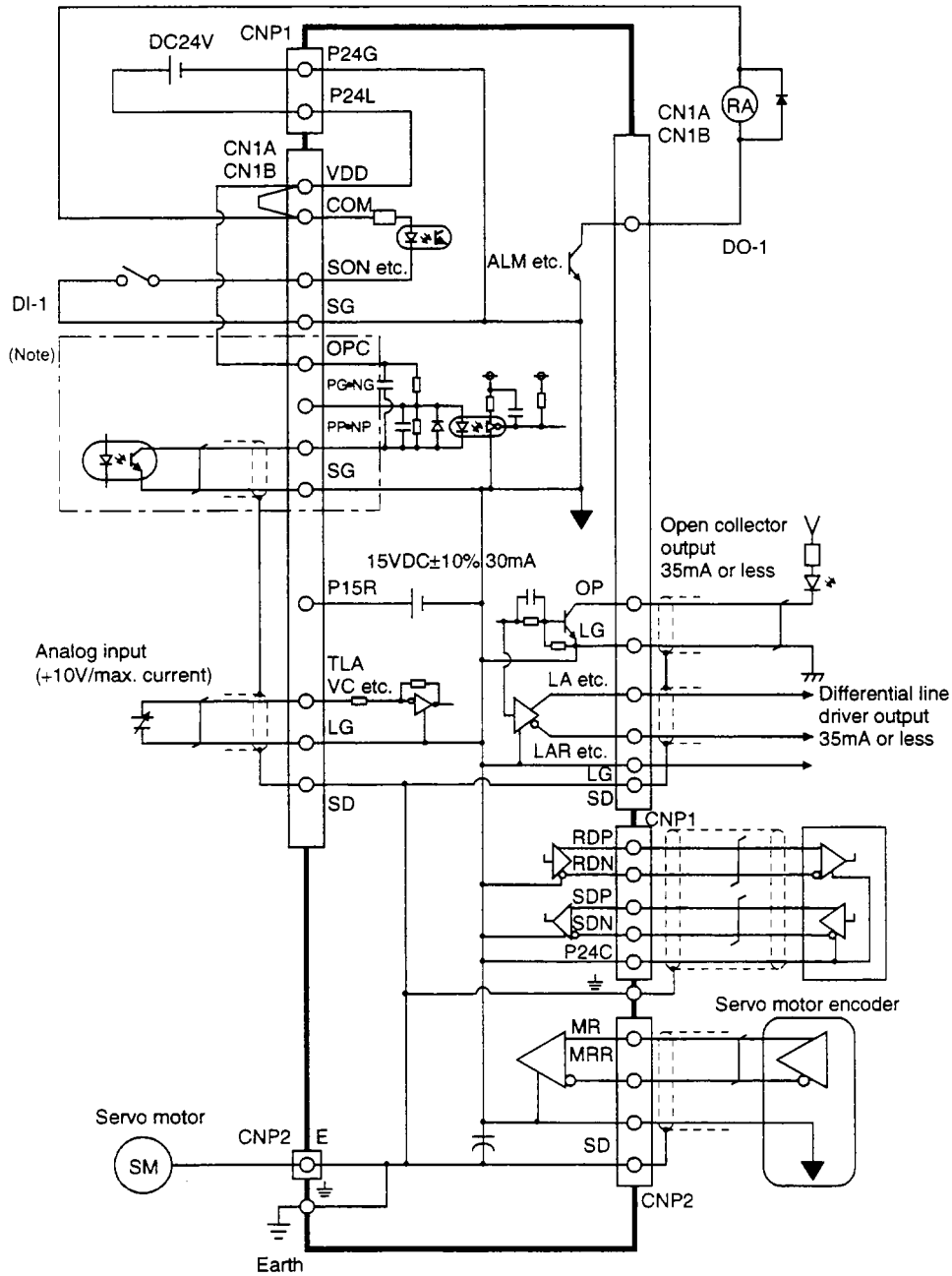
3) Position control mode

When an alarm occurs, the home position is lost. When resuming operation after deactivating the alarm, make a return to home position.

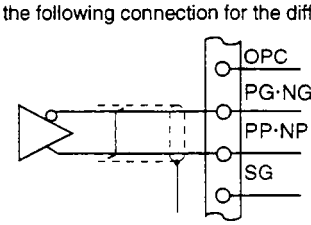
3.6 Interfaces

3.6.1 Common line

The following diagram shows the power supply and its common line.



Note: For the open collector pulse train input.
Make the following connection for the differential line driver pulse train input:



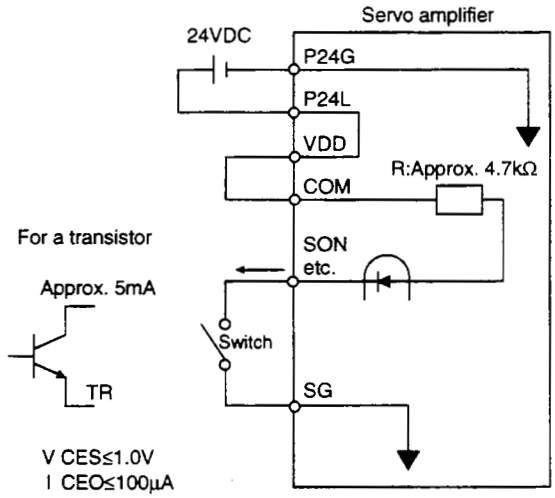
3.6.2 Detailed description of the interfaces

This section gives the details of the I/O signal interfaces (refer to I/O Division in the table) indicated in Section 3.3.2.

Refer to this section and connect the interfaces with the external equipment.

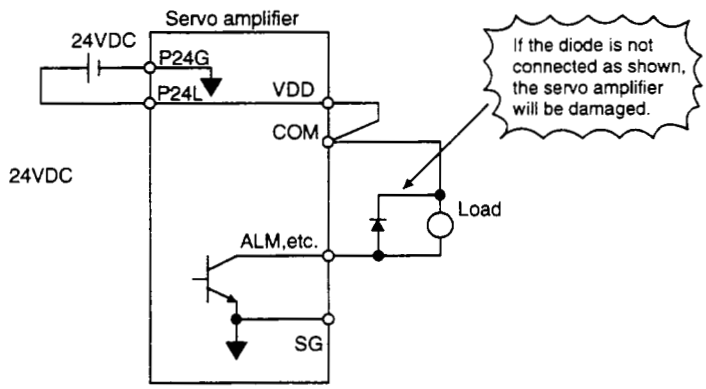
(1) Digital input interface DI-1

Give a signal with a relay or open collector transistor.



(2) Digital output interface DO-1

A lamp, relay or photocoupler can be driven. Provide a diode (D) for an inductive load, or an inrush current suppressing resister (R) for a lamp load. (Permissible current: 40mA or less, inrush current: 100mA or less)

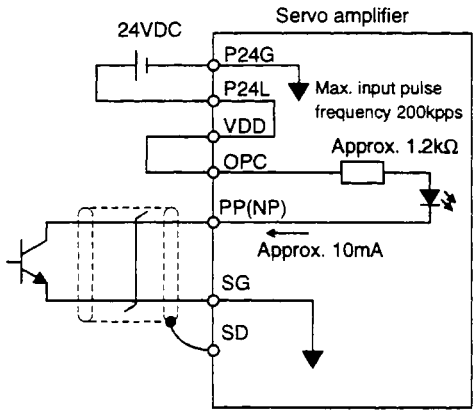


(3) Pulse train input interface DI-2

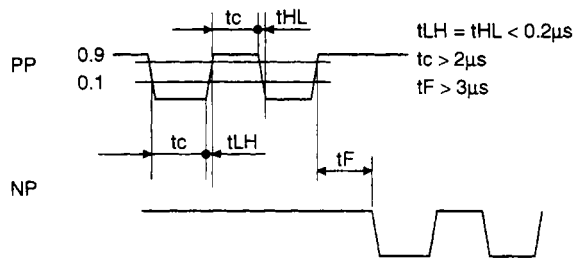
Provide a pulse train signal in the open collector or differential line driver system.

(a) Open collector system

1) Interface

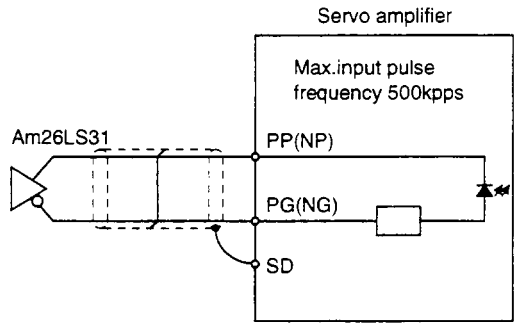


2) Conditions of the input pulse

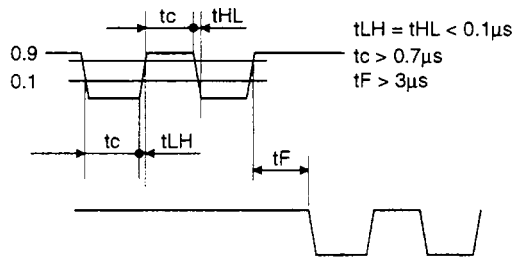


(b) Differential line driver system

1) Interface



2) Conditions of the input pulse

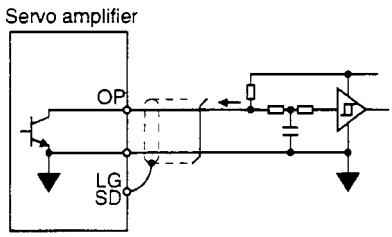


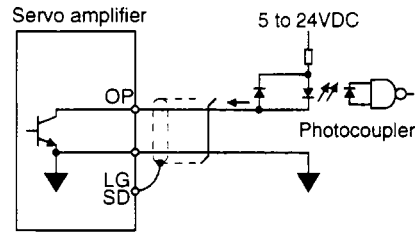
(4) Encoder pulse output DO-2

(a) Open collector system

Interface

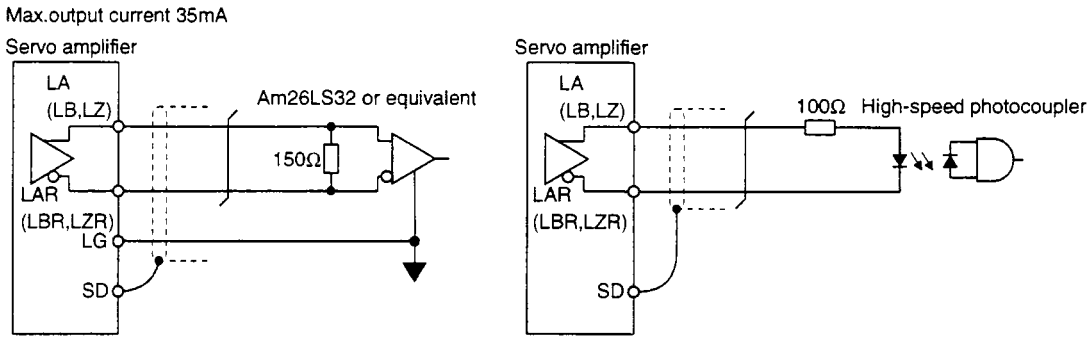
Max. output current 35mA



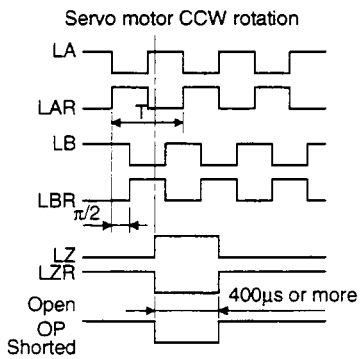


(b) Differential line driver system

1) Interface

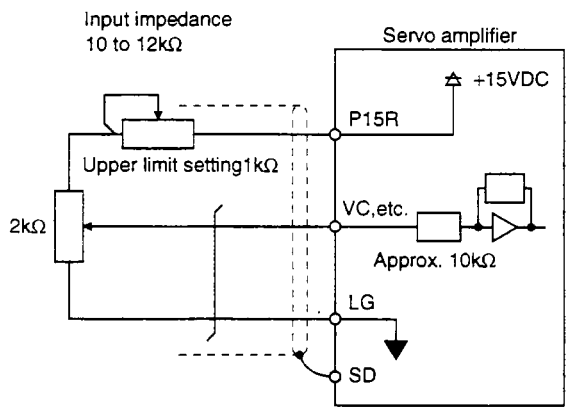


2) Output pulse



LZ signal varies ±3/8T on its leading edge.

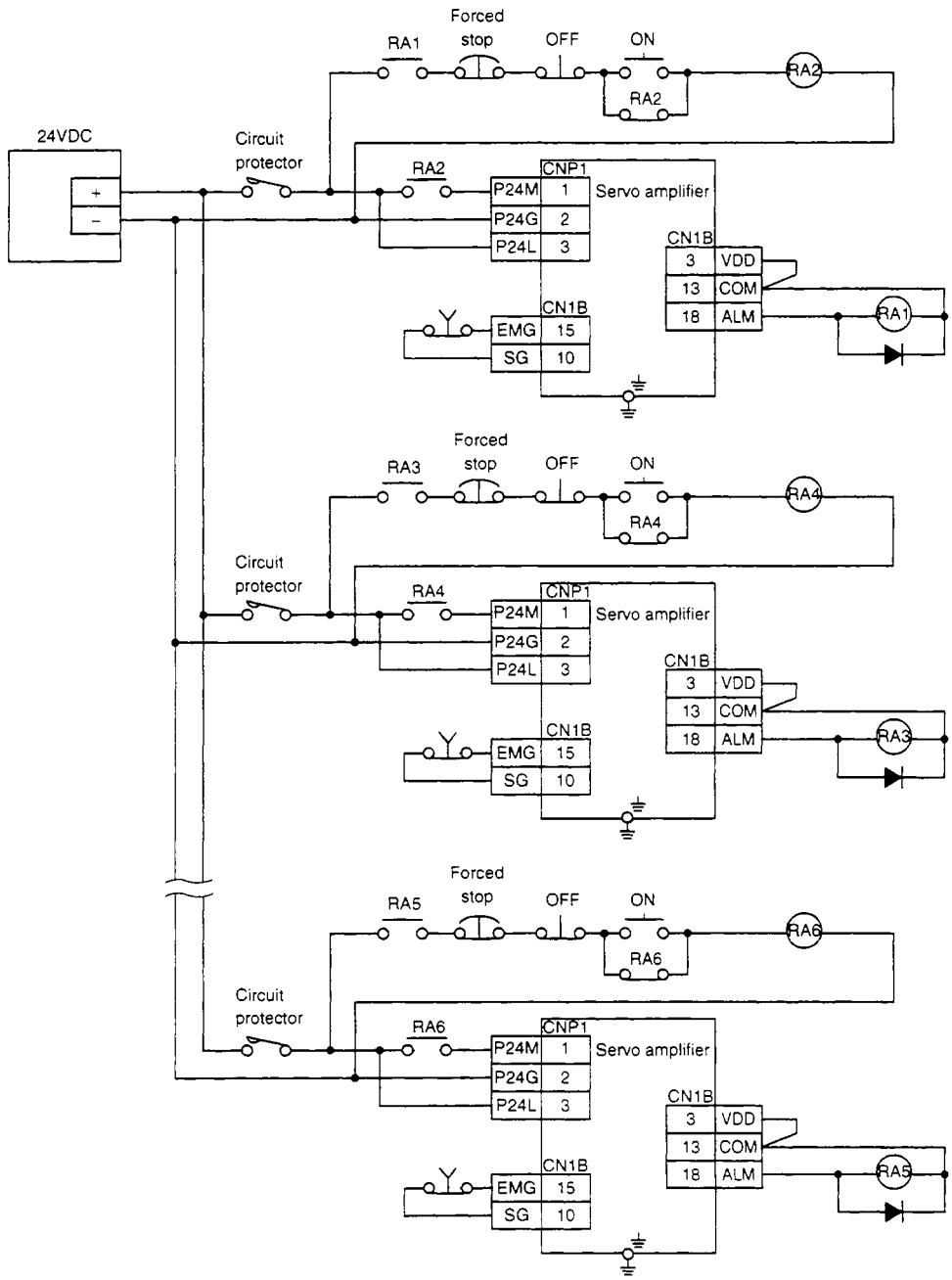
(5) Analog input



3.7 Input Power Supply Circuit

> **CAUTION**
>
> • When the servo amplifier has become faulty, switch power off on the servo amplifier power side. Continuous flow of a large current may cause a fire.

3.7.1 Connection example



Note: 1. When using an electromagnetic brake, determine the power supply by taking the rated current value of the electromagnetic brake into consideration.

2. Configure up the power supply circuit which will switch off power upon detection of alarm occurrence.

3.7.2 Explanation of signals

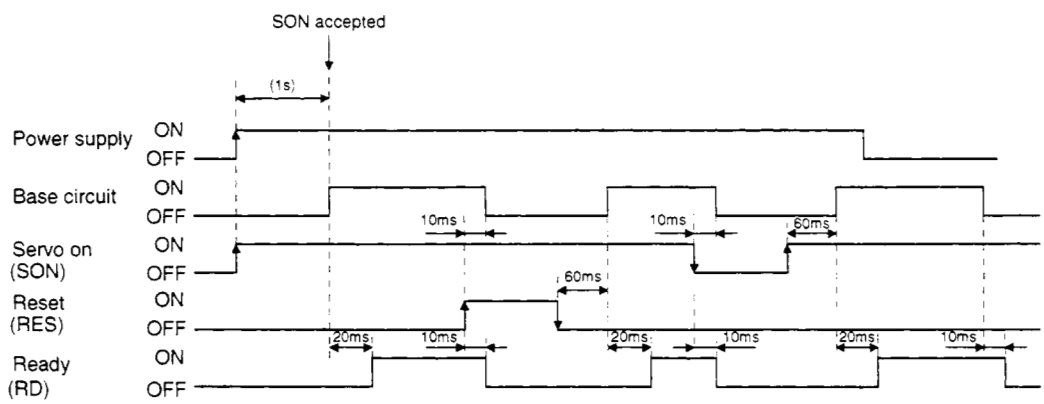
Abbreviation	Signal Name	Description
P24M	Main circuit power input	Power supply for main circuit
P24G	Power ground	Main circuit power supply and control power supply. Connected to SG and LG inside the unit.
P24L	Control power input	Control power supply and digital I/O power supply. Always use a stabilizing power supply.
⏚	Ground	Grounding terminal Connect to the earth of the control box for grounding.

3.7.3 Power-on sequence

(1) Power-on procedure

1) Always wire the power supply as shown in above Section 3.7.1 using the relay with the main circuit power supply. Configure up an external sequence to switch off the relay as soon as an alarm occurs.
2) Switch on the control circuit power supply P24L, P24G simultaneously with the main circuit power supply or before switching on the main circuit power supply. If the main circuit power supply is not on, the display shows the corresponding warning. However, by switching on the main circuit power supply, the warning disappears and the servo amplifier will operate properly.
3) The servo amplifier can accept the servo-on signal (SON) about 1 second after the main circuit power supply is switched on. Therefore, when SON is switched on simultaneously with the 24V power supply, the base circuit will switch on in about 1 second, and the ready signal (RD) will switch on in further about 20ms, making the servo amplifier ready to operate.

(2) Timing chart



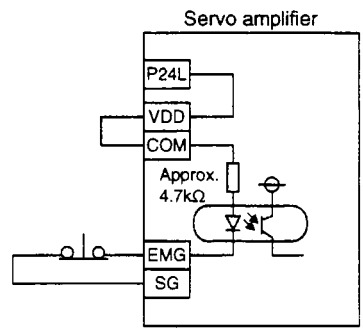
(3) Forced stop

> ⚠ CAUTION • To stop operation and switch power off immediately, provide a forced stop circuit.

Make up a circuit which shuts off main circuit power as soon as EMG-SG are opened at a forced stop. To ensure safety, always install a forced stop switch across EMG-SG. By disconnecting EMG-SG, the dynamic brake is operated to bring the servo motor to a sudden stop. At this time, the display shows the servo forced stop warning (A. E6).

During ordinary operation, do not use the forced stop signal to alternate stop and run.

If the start signal is on or a pulse train is input during a forced stop, the servo motor will rotate as soon as the warning is reset. During a forced stop, always shut off the run command.



(4) CNP1 connector wiring

The servo amplifier is packed with the following parts for wiring the CNP1.

For connection of the terminals and cables, use the crimping tool 57026-5000 (for UL1007) or 57027-5000 (for UL1015).

Part	Model	Maker
Connector	5557-08R	molex
Terminal	5556	

3.8 Servo Motor with Electromagnetic Brake

(1) Setting

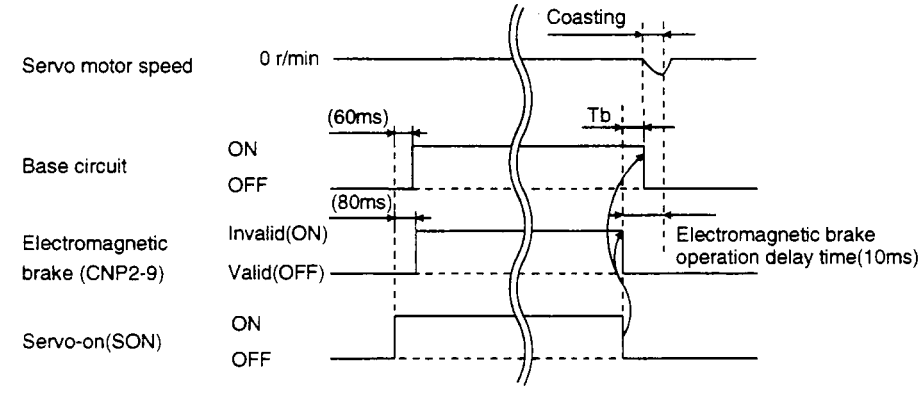
Using parameter No.33 (electromagnetic brake sequence output), set a time delay from electromagnetic brake operation to base circuit shut-off as in the timing chart shown in (2) in this section.

(2) Operation timing

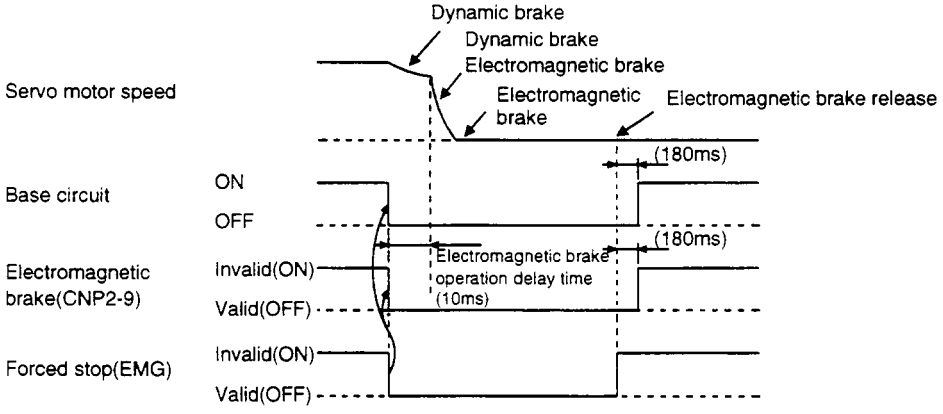
(a) Servo on signal command (from controller) ON/OFF

Tb after the servo-on signal is switched off, the base circuit is shut off and the servo motor coasts. The following chart shows the way of holding the motor shaft in vertical lift applications.

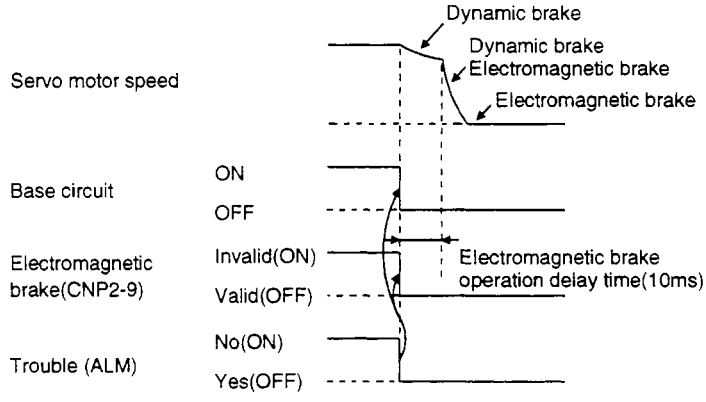
- Adjust Tb (parameter No. 33) to minimize a drop after the servo-on signal is switched off.
- Switch off the servo-on signal after the servo motor has stopped.



(b) Emergency stop signal (EMG) ON/OFF



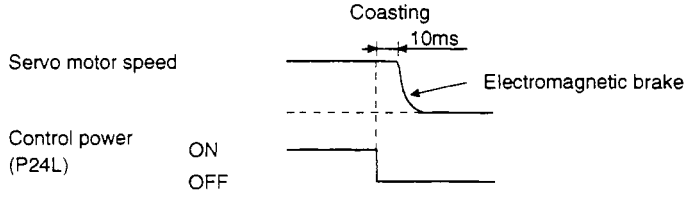
(c) Alarm occurrence



(d) Main circuit power off

When main circuit power switches off, the undervoltage alarm (A.10) occurs and the operation timing is as shown in (c) of this section.

(e) Control circuit power off



(3) Release of electromagnetic brake

To release the electromagnetic brake when main circuit power is off, use the output signal forced output (refer to Section 6.7).

The electromagnetic brake can be released by turning on the electromagnetic brake power B1 (CNP2-9).

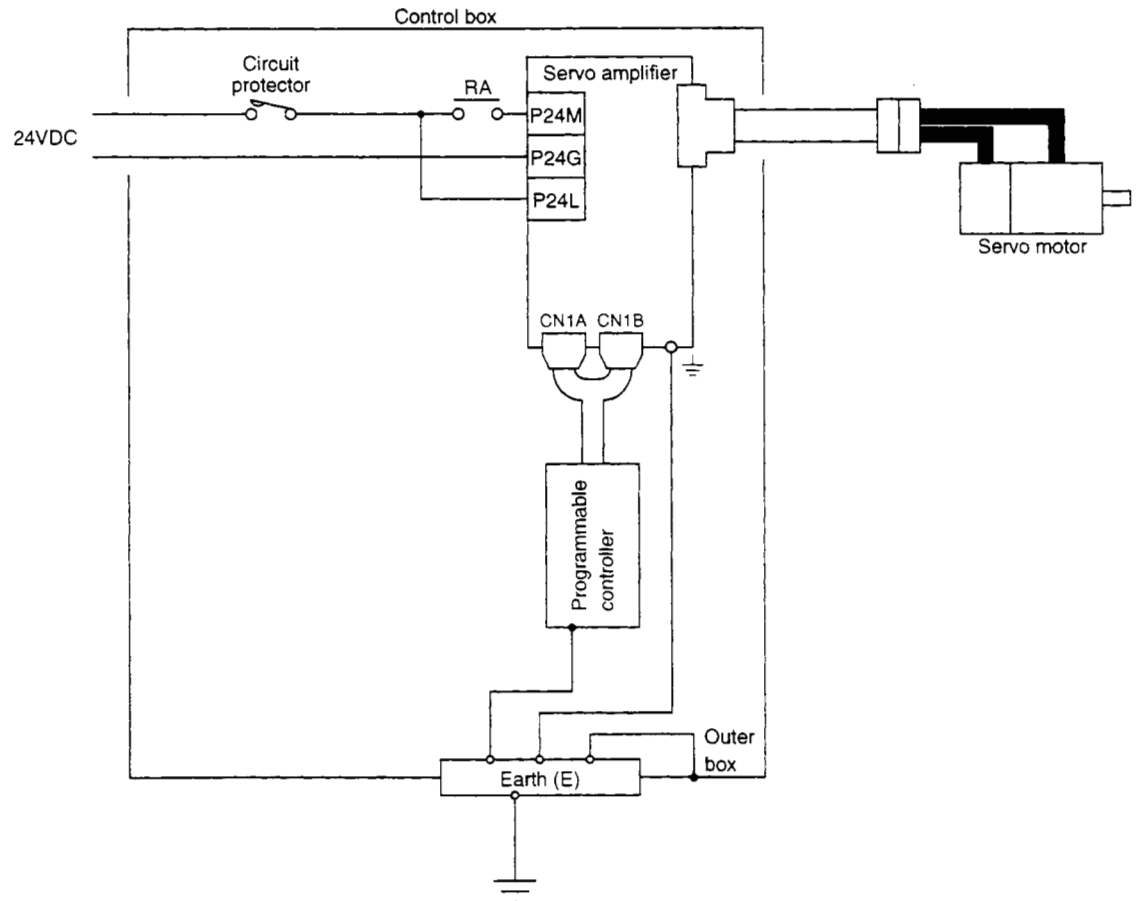
3.9 Grounding

> **⚠ WARNING**
>
> - Ground the servo amplifier and servo motor securely.
> - To prevent an electric shock, always connect the earth terminal (E) of the servo amplifier to the earth (E) of the control box (refer to (2) of this section for the fitting method of the earth terminal).

(1) Connection diagram

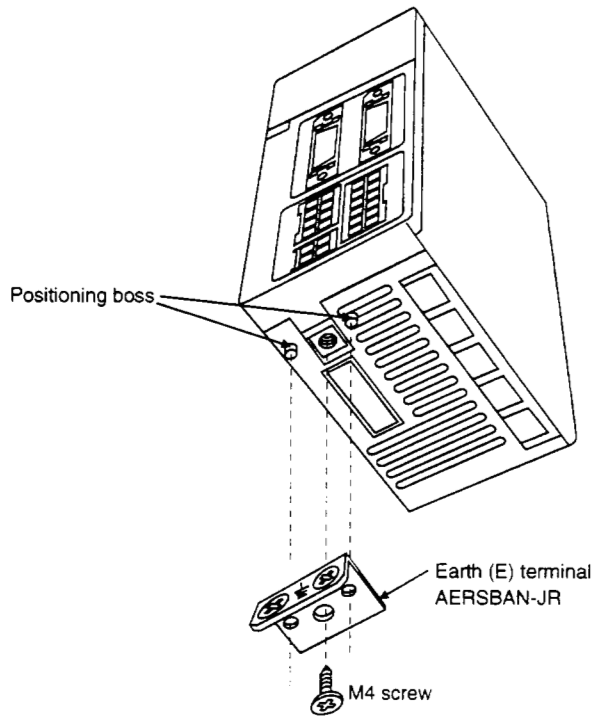
The servo amplifier switches the power transistor on-off to supply power to the servo motor. Depending on the wiring and ground cablerouting, the servo amplifier may be affected by the switching noise (due to di/dt and dv/dt) of the transistor. To prevent such a fault, refer to the following diagram and always ground.

To conform to the EMC Directive, refer to the EMC INSTALLATION GUIDELINES (IB(NA)67310).



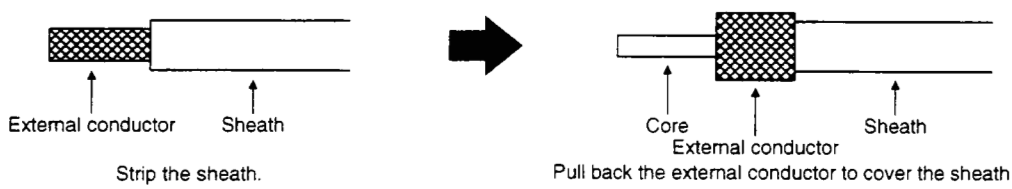
(2) Fitting of earth (E) terminal (AERSBAN-JR)

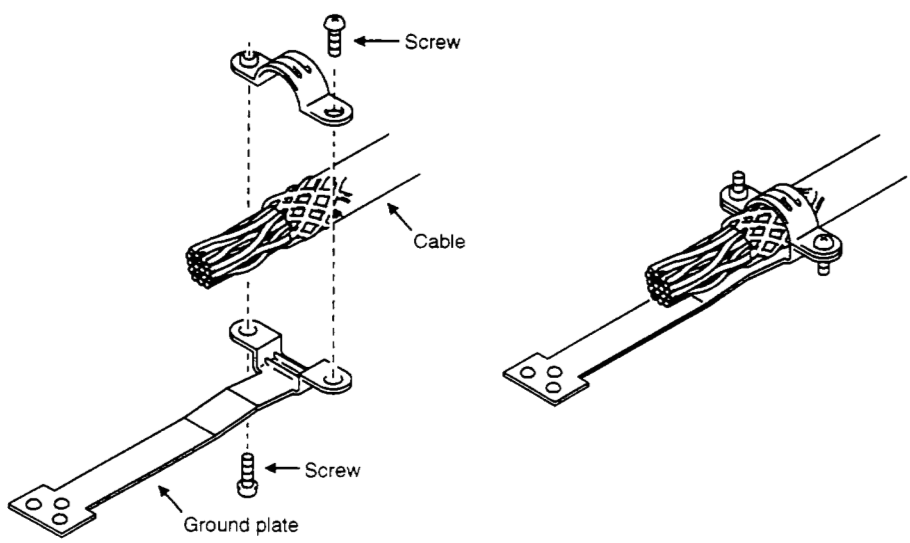
As shown below, fit the earth (E) terminal to the bottom or top of the servo amplifier.



3.10 Instructions for the 3M Connector

When fabricating an encoder cable or the like, securely connect the shielded external conductor of the cable to the ground plate as shown in this section and fix it to the connector shell.





4. OPERATION

4.1 When Switching Power On for the First Time

Before starting operation, check the following:

(1) Wiring

(a) A correct power supply is connected to the power input terminals (P24M · P24G · P24L) of the servo amplifier.

(b) The servo motor power supply terminals (U, V, W) of the servo amplifier match in phase with the power input terminals (U, V, W) of the servo motor.

(c) The servo motor power supply terminals (U, V, W) of the servo amplifier are not shorted to the power input terminals (P24M · P24L).

(d) The servo amplifier and servo motor are grounded securely.

(e) When stroke end limit switches are used, the signals across LSP-SG and LSN-SG are on during operation.

(f) 24VDC or higher voltages are not applied to the pins of connectors CN1A and CN1B.

(g) SD and SG of connectors CN1A and CN1B is not shorted.

(h) The wiring cables are free from excessive force.

(2) Environment

Signal cables and power cables are not shorted by wire offcuts, metallic dust or the like.

(3) Machine

(a) The screws in the servo motor installation part and shaft-to-machine connection are tight.

(b) The servo motor and the machine connected with the servo motor can be operated.

4.2 Startup

⚠ WARNING	• Do not operate the switches with wet hands. You may get an electric shock.

⚠ CAUTION	• Before starting operation, check the parameters. Some machines may perform unexpected operation. • During power-on or soon after power-off, do not touch the servo motor as they may be at high temperatures. You may get burnt.

Connect the servo motor with a machine after confirming that the servo motor operates properly alone.

4.2.1 Selection of control mode

Use parameter No. 0 to choose the control mode used. After setting, this parameter is made valid by switching power off, then on.

4.2.2 Position control mode

(1) Power on

(a) Switch off the servo on (SON) signal.

(b) When main circuit power/control circuit power is switched on, "C (Cumulative feedback pulses)" appears on the parameter unit.

(2) Test operation 1

Using jog operation in the "test operation mode", make sure that the servo motor operates. (Refer to Section 6.8.2.)

(3) Parameter setting

Set the parameters according to the structure and specifications of the machine. Refer to Chapter 5 for the parameter definitions and to Sections 7.8 for the setting method.

Parameter	Name	Setting	Description
No. 0	Select the control mode	□□□0	Fourth digit : Position control mode
No. 2	Auto tuning	□104	First digit: : Middle response (initial value) is selected. Second digit : Ordinary machine Third digit : Used
No. 3	Electronic gear numerator (CMX)	2	Electronic gear numerator
No. 4	Electronic gear denominator (CDV)	1	Electronic gear denominator

After setting the above parameters, switch power off once. Then switch power on again to make the set parameter values valid.

(4) Servo on

Switch the servo on in the following procedure:

(a) Switch on main circuit/control power.

(b) Switch on the servo on signal (SON) (short SON-SG).

When placed in the servo-on status, the servo amplifier is ready to operate and the servo motor is locked.

(5) Command pulse input

Entry of a pulse train from the positioning device rotates the servo motor. At first, run it at low speed and check the rotation direction, etc. If it does not run in the intended direction, check the input signal. On the status display, check the speed, command pulse frequency, load factor, etc. of the servo motor. When machine operation check is over, check automatic operation with the program of the positioning device.

This servo amplifier has a real-time auto tuning function under model adaptive control. Performing operation automatically adjusts gains. The optimum tuning results are provided by setting the response level appropriate for the machine in parameter No. 2.

(6) Zeroing

Make home position return as required.

(7) Stop

In any of the following statuses, the servo amplifier interrupts and stops the operation of the servo motor:

Refer to Section 3.8, (2) for the servo motor equipped with electromagnetic brake. Note that the stop pattern of stroke end (LSP/LSN) OFF is as described below.

(a) Servo on (SON) OFF

The base circuit is shut off and the servo motor coasts.

(b) Alarm occurrence

When an alarm occurs, the base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop.

(c) Forced stop (EMG) OFF

The base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop. Alarm A. E6 occurs.

(d) Stroke end (LSP/LSN) OFF

The servo motor is brought to a sudden stop and servo-locked. The motor may be run in the opposite direction.

4.2.3 Speed control mode

(1) Power on

(a) Switch off the servo on (SON) signal.

(b) When main circuit power/control circuit power is switched on, "r (motor speed)" appears on the parameter unit.

(2) Test operation

Using jog operation in the "test operation mode" of the Parameter unit, make sure that the servo motor operates. (Refer to Section 6.8.2.)

(3) Parameter setting

Set the parameters according to the structure and specifications of the machine. Refer to Chapter 5 for the parameter definitions and to Sections 6.5 for the setting method.

Parameter	Name	Setting	Description
No. 0	Select the control mode	□□□2	First digit : Speed control mode
No. 2	Auto tuning	□104	First digit : Middle response (initial value) is selected. Second digit : Ordinary machine Third digit : Used
No. 8	Internal speed command 1	1000	Set 1000r/min.
No. 9	Internal speed command 2	1500	Set 1500r/min.
No. 10	Internal speed command 3	2000	Set 2000r/min.
No. 11	Acceleration time constant	1000	Set 1000ms.
No. 12	Deceleration time constant	500	Set 500ms.
No. 13	S-pattern acceleration/deceleration time constant	0	Not used

After setting the above parameters, switch power off once. Then switch power on again to make the set parameter values valid.

(4) Servo on

Switch the servo on in the following procedure:

(a) Switch on main circuit/control power.

(b) Switch on the servo on signal (SON) (short SON-SG).

When placed in the servo-on status, the servo amplifier is ready to operate and the servo motor is locked.

(5) Start

Using speed selection 1 (SP1) and speed selection 2 (SP2), choose the servo motor speed. Turn on forward rotation start (ST1) to run the motor in the forward rotation (CCW) direction or reverse rotation start (ST2) to run it in the reverse rotation (CW) direction. At first, set a low speed and check the rotation direction, etc. If it does not run in the intended direction, check the input signal.

On the status display, check the speed, load factor, etc. of the servo motor.

When machine operation check is over, check automatic operation with the host controller or the like.

This servo amplifier has a real-time auto tuning function under model adaptive control. Performing operation automatically adjusts gains. The optimum tuning results are provided by setting the response level appropriate for the machine in parameter No. 2.

(6) Stop

In any of the following statuses, the servo amplifier interrupts and stops the operation of the servo motor:

Refer to Section 3.8, (2) for the servo motor equipped with electromagnetic brake. Note that simultaneous ON or simultaneous OFF of stroke end (LSP, LSN) OFF and forward rotation start (ST1) or reverse rotation start (ST2) signal has the same stop pattern as described below.

(a) Servo on (SON) OFF

The base circuit is shut off and the servo motor coasts.

(b) Alarm occurrence

When an alarm occurs, the base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop.

(c) Forced stop (EMG) OFF

The base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop. Alarm A. E6 occurs.

(d) Stroke end (LSP/LSN) OFF

The servo motor is brought to a sudden stop and servo-locked. The motor may be run in the opposite direction.

(e) Simultaneous ON or simultaneous OFF of forward rotation start (ST1) and reverse rotation start (ST2) signals

The servo motor is decelerated to a stop.

4.2.4 Torque control mode

(1) Power on

(a) Switch off the servo on (SON) signal.

(b) When main circuit power/control circuit power is switched on, "U (torque command voltage)" appears on the parameter unit.

(2) Test operation

Using jog operation in the "test operation mode" of the Parameter unit, make sure that the servo motor operates. (Refer to Section 6.8.2.)

(3) Parameter setting

Set the parameters according to the structure and specifications of the machine. Refer to Chapter 5 for the parameter definitions and to Sections 6.5 for the setting method.

Parameter	Name	Setting	Description
No. 0	Select the control mode	□□□4	First digit : Torque control mode
No. 8	Internal speed command 1	1000	Set 1000r/min.
No. 9	Internal speed command 2	1500	Set 1500r/min.
No. 10	Internal speed command 3	2000	Set 2000r/min.
No. 11	Acceleration time constant	1000	Set 1000ms.
No. 12	Deceleration time constant	500	Set 500ms.
No. 13	S-pattern acceleration/deceleration time constant	0	Not used
No. 14	Torque command time constant	2000	Set 2000ms
No. 28	Internal torque limit 1	50	Controlled to 50% output

After setting the above parameters, switch power off once. Then switch power on again to make the set parameter values valid.

(4) Servo on

Switch the servo on in the following procedure:

1) Switch on main circuit/control power.

2) Switch on the servo on signal (SON) (short SON-SG).

When placed in the servo-on status, the servo amplifier is ready to operate and the servo motor is locked.

(5) Start

Using speed selection 1 (SP1) and speed selection 2 (SP2), choose the servo motor speed. Turn on forward rotation select (DI4) to run the motor in the forward rotation (CCW) direction or reverse rotation select (DI3) to run it in the reverse rotation (CW) direction, generating torque. At first, set a low speed and check the rotation direction, etc. If it does not run in the intended direction, check the input signal.

On the status display, check the speed, load factor, etc. of the servo motor.

When machine operation check is over, check automatic operation with the host controller or the like.

(6) Stop

In any of the following statuses, the servo amplifier interrupts and stops the operation of the servo motor:

Refer to Section 3.8, (2) for the servo motor equipped with electromagnetic brake.

(a) Servo on (SON) OFF

The base circuit is shut off and the servo motor coasts.

(b) Alarm occurrence

When an alarm occurs, the base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop.

(c) Forced stop (EMG) OFF

The base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop. Alarm A. E6 occurs.

4.3 Multidrop Communication

You can use the RS-422 communication function to operate two or more servo amplifiers on the same bus. In this case, set station numbers to the servo amplifiers to recognize the servo amplifier to which the current data is being sent. Use parameter No. 15 to set the station numbers.

Always set one station number to one servo amplifier. Normal communication cannot be made if the same station number is set to two or more servo amplifiers.

For details, refer to Chapter 13.

5. PARAMETERS

> **⚠ CAUTION** • Never adjust or change the parameter values extremely as it will make operation instable.

5.1 Parameter List

5.1.1 Parameter write inhibit

> **POINT**
> • After setting the parameter No. 19 value, switch power off, then on to make that setting valid.

In the MR-J2-03A5 servo amplifier, its parameters are classified into the basic parameters (No. 0 to 19) and expansion parameters (No. 20 to 49) according to their safety aspects and frequencies of use. In the factory setting condition, the customer can change the basic parameter values but cannot change the expansion parameter values. When fine adjustment, e.g. gain adjustment, is required, change the parameter No. 19 setting to make the expansion parameters write-enabled.

Parameter No. 19 Setting	Operation	Basic Parameters No. 0 to No. 19	Expansion Parameters No. 20 to No. 49
0000 (initial value)	Reference	○	
	Write	○	
000A	Reference	No. 19 only	
	Write	No. 19 only	
000B	Reference	○	○
	Write	○	
000C	Reference	○	○
	Write	○	○

5.1.2 Lists

> **POINT**
>
> • For any parameter whose symbol is preceded by*, set the parameter value and switch power off once, then switch it on again to make that parameter setting valid.

For details of the parameters, refer to the corresponding items.
The symbols in the Control Mode column of the table indicate the following modes:
P : Position control mode
S : Speed control mode
T : Torque control mode

(1) Item list

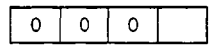
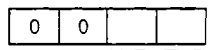
	No.	Symbol	Name	Control Mode	Initial Value	Unit	Customer Setting
Basic parameters	0	*STY	Control mode selection	P · S · T	0000		
	1	*OP1	Function selection 1	P · S · T	0002		
	2	ATU	Auto tuning	P · S	0104		
	3	CMX	Electronic gear (Command pulse multiplying factor numerator)	P	1		
	4	CDV	Electronic gear (Command pulse multiplying factor denominator)	P	1		
	5	INP	In-position range	P	100	pulse	
	6	PG1	Position loop gain 1	P	145	rad/s	
	7	PST	Position command acceleration/deceleration time constant (Smoothing)	P	3	ms	
	8	SC1	Internal speed command 1	S	100	r/min	
			Internal speed limit 1	T	100	r/min	
	9	SC2	Internal speed command 2	S	500	r/min	
			Internal speed limit 2	T	500	r/min	
	10	SC3	Internal speed command 3	S	1000	r/min	
			Internal speed limit 3	T	1000	r/min	
	11	STA	Acceleration time constant	S · T	0	ms	
	12	STB	Deceleration time constant	S · T	0	ms	
	13	STC	S-pattern acceleration/deceleration time constant	S · T	0	ms	
	14	TQC	Torque command time constant	T	0	ms	
	15	*SNO	Station number setting	P · S · T	0	station	
	16	*BPS	Communication baudrate selection, alarm history clear	P · S · T	0000		
	17		Spare		0		
	18	*DMD	Status display selection	P · S · T	0000		
	19	*BLK	Parameter block	P · S · T	0000		

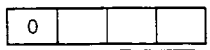
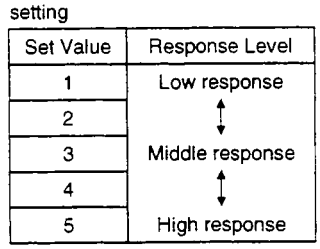
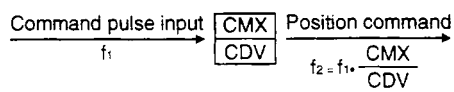
	No.	Symbol	Name	Control Mode	Initial Value	Unit	Customer Setting
Basic parameters	20	*OP2	Function selection 2	P · S · T	0000		
	21	*OP3	Function selection 3 (Command pulse selection)	P	0000		
	22	*OP4	Function selection 4	P · S · T	0000		
	23	FFC	Feed forward gain	P	0	%	
	24	ZSP	Zero speed	P · S · T	50	r/min	
	25	VCM	Analog speed command maximum speed	S	(Note1) 0	(r/min)	
			Analog speed limit maximum speed	T	(Note1) 0	(r/min)	
	26	TLC	Analog torque command maximum output	T	100	%	
	27	*ENR	Encoder output pulses	P · S · T	4000	pulse	
	28	TL1	Internal torque limit 1	P · S · T	100	%	
	29	VCO	Analog speed command offset	S	(Note2)	mV	
			Analog speed limit offset	T	(Note2)	mV	
	30	TLO	Analog torque command offset	T	0	mV	
			Analog torque limit offset	S	0	mV	
	31		Spare		0		
	32		Spare		0		
	33	MBR	Electromagnetic brake sequence output	P · S · T	0	ms	
	34	GD2	Ratio of load inertia moment to servo motor inertia moment	P · S · T	3.0	×0.1 times	
	35	PG2	Position loop gain 2	P	97	rad/s	
	36	VG1	Speed loop gain 1	P · S	873	rad/s	
	37	VG2	Speed loop gain 2	P · S	1144	rad/s	
	38	VIC	Speed integral compensation	P · S	20	ms	
	39	VDC	Speed differential compensation	P · S	980		
	40		Spare		0		
	41	*DIA	Input signal automatic ON selection	P · S · T	0000		
	42	*DI1	Input signal selection 1	P · S · T	0003		
	43	*DI2	Input signal selection 2 (CN1B-pin 5)	P · S · T	0111		
	44	*DI3	Input signal selection 3 (CN1B-pin 14)	P · S · T	·0222		
	45	*DI4	Input signal selection 4 (CN1A-pin 8)	P · S · T	0665		
	46	*DI5	Input signal selection 5 (CN1B-pin 7)	P · S · T	0770		
	47	*DI6	Input signal selection 6 (CN1B-pin 8)	P · S · T	0883		
	48	*DI7	Input signal selection 7 (CN1B-pin 9)	P · S · T	0994		
	49	*DO1	Output signal selection 1	P · S · T	0000		

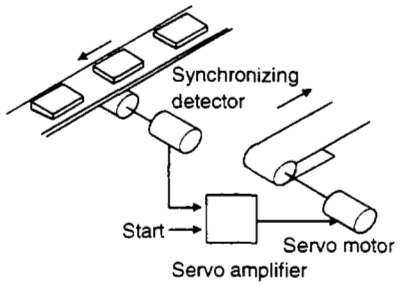
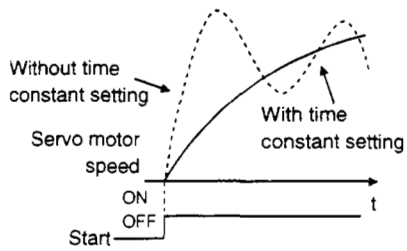
Note 1. The setting of "0" provides the rated servo motor speed.

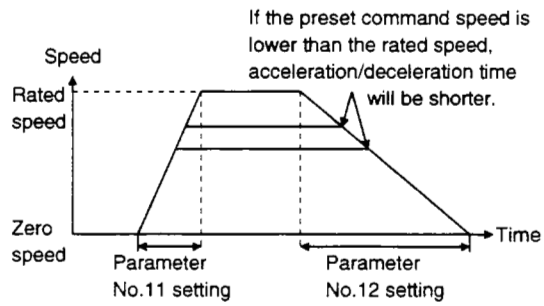
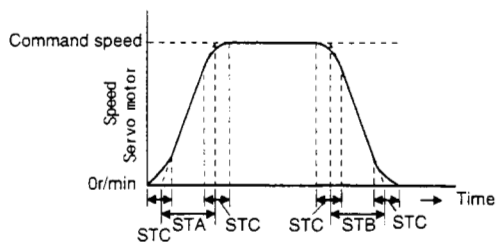
2. Depends on the servo amplifier.

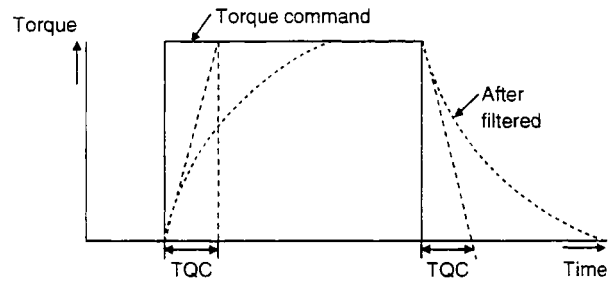
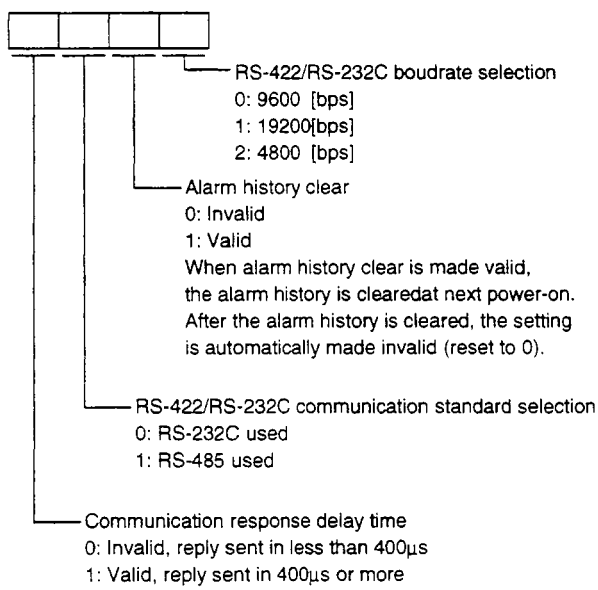
(2) Details list

Class	No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode
Basic parameters	0	*STY	Control mode, regenerative brake option selection Used to select the control mode and regenerative brake option.  Select the control mode. 0:Position 1:Position and speed 2:Speed 3:Speed and torque 4:Torque 5:Torque and position	0000		0000h to 0005h	P · S · T
	1	*OP1	Function selection 1: Used to select the input signal filter and CN1B-pin 19's output signal.  Input signal filter If external input signal causes chattering due to noise, etc., input filter is used to suppress it. 0:None 1:1.77[ms] 2:3.55[ms] CN1B-pin 19's function selection 0:Zero Speed detection signal 1:Electromagnetic brake interlock sugnal	0002		0000h to 0012h	P · S · T

<table>
<tr><th>Class</th><th>No.</th><th>Symbol</th><th>Name and Function</th><th>Initial Value</th><th>Unit</th><th>Setting Range</th><th>Control Mode</th></tr>
<tr><td rowspan="3">Basic parameters</td><td>2</td><td>ATU</td><td>Auto tuning:
Used to set the response level, etc. for execution of auto tuning.
 
Auto tuning response level setting
 
Set Value / Response Level
1: Low response
2
3: Middle response
4
5: High response
If the macine hunts or generates large gear sound, decrease the set value.
To improve performance, e.g. shorten the settling time, increase the set value.
Select the machine.
For example, used to improve the position setting characteristic when friction is large.
0: Ordinary machine
1: Machine with large friction
Auto tuning selection
0: Auto tuning selected for use of interpolation axis control, etc. in position control
1: Auto tuning for ordinary operation
2: No auto tuning</td><td>0104</td><td></td><td>0001h
to
0215h</td><td>P · S</td></tr>
<tr><td>3</td><td>CMX</td><td>Electronic gear numerator:
Set the value within the range of $\frac{1}{50} < \frac{CMX}{CDV} < 50$
If $\frac{1}{100} < \frac{CMX}{CDV} < 100$ is exceeded, a parameter error will occur.</td><td>1</td><td></td><td>1
to
32767</td><td>P</td></tr>
<tr><td>4</td><td>CDV</td><td>Always set the electronic gear in the servo off status to prevent misoperation due to wrong setting
For the setting, refer to Section 5.2.1.
Set the multiplier for the command pulse input.
 
Command pulse input f_1 → CMX/CDV → Position command $f_2 = f_1 \cdot \frac{CMX}{CDV}$
Note: Set the value within the range of $\frac{1}{50} < \frac{CMX}{CDV} < 50$ as a guideline.
Use the following formula to change the setting of input pulse count per servo motor revolution.
(Example: HC-AQ series: 8192 pulses/rev)
$8192 \cdot \frac{CDV}{CMX}$ (pulse/rev)</td><td>1</td><td></td><td>1
to
32767</td><td>P</td></tr>
</table>

Class	No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode
Basic parameters	5	INP	In-position range: Used to set the droop pulse range in which the imposition (INP) signal will be output.	100	pulse	0 to 10000	P
	6	PG1	Position loop gain 1: Used to set the gain of position loop 1. Increase the gain to improve trackability in response to the position command.	145	red/s	4 to 1000	P
	7	PST	Position command acceleration/deceleration time constant (smoothing): Used to set the time constant of a low pass filter in response to the position command. Example: When a command is given from a synchronizing detector, synchronous operation can be started smoothly if started during line operation.  	3	ms	0 to 20000	P
	8	SC1	Internal speed command 1: Used to set speed 1 of internal speed commands.	100	r/min	0 to instantaneous permissible speed	S
			Internal speed limit 1: Used to set speed 1 of internal speed limits.				T
	9	SC2	Internal speed command 2: Used to set speed 2 of internal speed commands.	500	r/min	0 to instantaneous permissible speed	S
			Internal speed limit 2: Used to set speed 2 of internal speed limits.				T

Class	No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode
Basic parameters	10	SC3	Internal speed command 3: Used to set speed 3 of internal speed commands.	1000	r/min	0 to instantaneous permissible speed	S
			Internal speed limit 3: Used to set speed 3 of internal speed limits.				T
	11	STA	Acceleration time constant: Used to set the acceleration time required to reach the rated speed from zero speed in response to the analog speed command and internal speed commands 1 to 3.  Example: Set 3000 (3s) to increase speed from 0r/min to 1000r/min in 1 second. POINT • When configuring an external position loop, set 0 or minimal values in parameters No. 11 and 12.	0	ms	0 to 20000	S · T
	12	STB	Deceleration time constant: Used to set the deceleration time required to reach zero speed from the rated speed in response to the analog speed command and internal speed commands 1 to 3.	0			
	13	STC	S-pattern acceleration/deceleration time constant: Used to smooth start/stop of the servo motor.  STA: Aeceleration time constant (parameter No.11) STB: Deceleration time constant (parameter No.12) STC: S-pattern acceleration/deceleration time constant (parameter No.13)	0	ms	0 to 1000	S · T

Class	No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode
Basic parameters	14	TQC	Torque command time constant: Used to set the constant of a low pass filter in response to the torque command.  TQC: Torque command time constant	0	ms	0 to 20000	T
	15	*SNO	Station number setting Used to specify the station number for multidrop communication. Always set one station to one axis of servo amplifier. If one station number is set to two or more stations, normal communication cannot be made.	0	sta-tion	0 to 31	P·S·T
	16	*BPS	Communication baudrate selection, alarm history clear: Used to select the communication baudrate for use of the set-up software and to clear the alarm history.  	0000		0000h to 1112h	P·S·T
	17		Spare	0			

<table>
<tr><th>Class</th><th>No.</th><th>Symbol</th><th>Name and Function</th><th>Initial Value</th><th>Unit</th><th>Setting Range</th><th>Control Mode</th></tr>
<tr><td rowspan="2">Basic parameters</td><td>18</td><td>*DMD</td><td>Status display selection:
Used to select the status display shown at power-on.

0 0 ☐ ☐

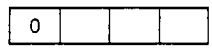
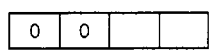
Selection of status display at power-on
0: Cumulative feedback pulses
1: Servo motor speed
2: Droop pulses
3: Cumulative command pulses
4: Command pulse frequency
5: Analog speed command voltage (Note 1)
6: Analog torque command voltage (Note 2)
7: Regenerative load ratio
8: Effective load ratio
9: Peak load ratio
A: Within one-revolution position
B: ABS counter
C: Load inertia moment ratio

Note: 1. In speed control mode. Analog speed limit voltage in torque control mode.
2. In torque control mode. Analog torque limit voltage in speed or position control mode.

Status display at power-on in corresponding control mode
0: Depends on the control mode.

<table><tr><th>Control Mode</th><th>Status Display at Power-On</th></tr><tr><td>Position</td><td>Cumulative feedback pulses</td></tr><tr><td>Position/speed</td><td>Cumulative feedback pulses/servo motor speed</td></tr><tr><td>Speed</td><td>Servo motor speed</td></tr><tr><td>Speed/torque</td><td>Servo motor speed/analog torque command voltage</td></tr><tr><td>Torque</td><td>Analog torque command voltage</td></tr><tr><td>Torque/position</td><td>Analog torque command voltage/cumulative feedback pulses</td></tr></table>
1: Depends on the first digit setting of this parameter.</td><td>0000</td><td></td><td>0000h
to
001Ch</td><td>P · S · T</td></tr>
<tr><td>19</td><td>*BLK</td><td>Parameter block:
Used to select the reference and write ranges of the parameters.

<table><tr><th>Set Value</th><th>Operation</th><th>Basic Parameters No. 0 to No. 19</th><th>Expansion Parameters No. 20 to No. 49</th></tr><tr><td rowspan="2">0000
(Initial value)</td><td>Reference</td><td>○</td><td></td></tr><tr><td>Write</td><td>○</td><td></td></tr><tr><td rowspan="2">000A</td><td>Reference</td><td>No. 19 only</td><td></td></tr><tr><td>Write</td><td>No. 19 only</td><td></td></tr><tr><td rowspan="2">000B</td><td>Reference</td><td>○</td><td>○</td></tr><tr><td>Write</td><td>○</td><td></td></tr><tr><td rowspan="2">000C</td><td>Reference</td><td>○</td><td>○</td></tr><tr><td>Write</td><td>○</td><td>○</td></tr></table></td><td>0000</td><td></td><td>0000h
to
000Ch</td><td>P · S · T</td></tr>
</table>

Class	No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode
Expansion parameters	20	*OP2	Function selection 2: Used to select restart after instantaneous power failure, servo lock at a stop in speed control mode, and slight vibration suppression control.  Restart after instantaneous power failure If the input power supply voltage had reduced in the speed control mode to stop the servo motor due to the undervoltage alarm (A. 10) but the supply voltage has returned to normal, the servo motor can be restarted by merely switching on the start signal without resetting the alarm. 0: Invalid 1: Valid Stop-time servo lock selection The shaft can be servo-locked to remain still at a stop in the speed control mode. 0: Valid 1: Invalid Slight vibration suppression control Used to suppress vibration at a stop. 0: Invalid 1: Valid	0000		0000h to 0111h	S P
	21	*OP3	Function selection 3 (Command pulse selection) : Used to select the input form of the pulse train input signal. (Refer to Section 3.4.1.)  Command pulse train input form 0: Forward/reverse rotation pulse train 1: Signed pulse train 2: A/B phase pulse train Pulse train logic selection 0: Positive logic 1: Negative logic	0000		0000h to 0012h	P

<table>
<tr><th>Class</th><th>No.</th><th>Symbol</th><th>Name and Function</th><th>Initial Value</th><th>Unit</th><th>Setting Range</th><th>Control Mode</th></tr>
<tr><td>Expansion parameters</td><td>22</td><td>*OP4</td><td>Function selection 4:
Used to select stop processing at LSP/LSN signal off and choose the machine resonance suppression filter.

[ ][ ][0][ ]

How to make a stop when LSP/LSN signal is valid.
0: Sudden stop
1: Slow stop
· In the position control mode, the servo motor is decelerated to a stop according to parameter No. 7 setting.
· In the speed control mode, the servo motor is decelerated to a stop according to parameter No. 12 setting.

VC/VLA voltage averaging
Used to set the filtering time when the analog speed command (VC) voltage or analog speed limit (VLA) is imported. Set 0 to vary the speed to voltage fluctuation in real time. Increase the set value to vary the speed slower to voltage fluctuation.

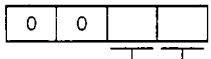
<table><tr><th>Set Value</th><th>Filtering Time [ms]</th></tr><tr><td>0</td><td>0</td></tr><tr><td>1</td><td>1.77</td></tr><tr><td>2</td><td>3.55</td></tr><tr><td>3</td><td>7.11</td></tr></table>
Machine resonance suppression filter

<table><tr><th>Set Value</th><th>Notch Frequency [Hz]</th></tr><tr><td>0</td><td>Not used</td></tr><tr><td>1</td><td>1125</td></tr><tr><td>2</td><td>563</td></tr><tr><td>3</td><td>375</td></tr><tr><td>4</td><td>282</td></tr><tr><td>5</td><td>225</td></tr><tr><td>6</td><td>188</td></tr><tr><td>7</td><td>161</td></tr></table></td><td>0000</td><td></td><td>0000h
to
7301h</td><td>P · S · T</td></tr>
</table>

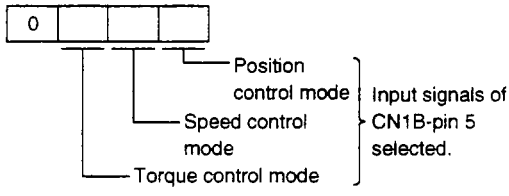
<table>
<tr><th>Class</th><th>No.</th><th>Symbol</th><th>Name and Function</th><th>Initial Value</th><th>Unit</th><th>Setting Range</th><th>Control Mode</th></tr>
<tr><td rowspan="8">Expansion parameters</td><td>23</td><td>FFC</td><td>Feed forward gain:
Used to set the fee forward gain.
When it is set to 100%, droop pulses will not be generated in constant-speed operation. Note that sudden acceleration/deceleration will increase overshoot.
When setting this parameter, always set auto tuning (parameter No. 2) to "No"</td><td>0</td><td>%</td><td>0
to
100</td><td>P</td></tr>
<tr><td>24</td><td>ZSP</td><td>Zero speed:
Used to set the output range of the zero speed signal (ZSP).</td><td>50</td><td>r/min</td><td>0
to
10000</td><td>P·S·T</td></tr>
<tr><td rowspan="2">25</td><td rowspan="2">VCM</td><td>Analog speed command maximum speed:
Used to set the speed at the maximum input voltage (10V) of the analog speed command (VC).
Set 0 to select the rated speed.</td><td rowspan="2">0</td><td rowspan="2">r/min</td><td>0
1
to
10000</td><td>S</td></tr>
<tr><td>Analog speed limit maximum speed:
Used to set the speed at the maximum input voltage (10V) of the analog speed limit (VLA).
Set 0 to select the rated speed.</td><td>0
1
to
10000</td><td>T</td></tr>
<tr><td>26</td><td>TLC</td><td>Analog torque command maximum output:
Used to set the output torque at the analog torque command voltage (TC = ±8V) of +8V on the assumption that the maximum torque is 100[%]. For example, set 50 to output (maximum torque × 50/100) at the TC of +8V.</td><td>100</td><td>%</td><td>0
to
1000</td><td>T</td></tr>
<tr><td>27</td><td>*ENR</td><td>Encoder output pulses:
Used to set the number of output pulses per encoder revolution output by the servo amplifier.</td><td>4000</td><td>pulse</td><td>5
to
16384</td><td>P·S·T</td></tr>
<tr><td rowspan="2">28</td><td rowspan="2">TL1</td><td>Internal torque limit 1:
Set this parameter to limit servo motor-generated torque on the assumption that the maximum torque is 100[%]. When 0 is set, torque is not produced.</td><td rowspan="2">100</td><td rowspan="2">%</td><td rowspan="2">0
to
100</td><td>T</td></tr>
<tr><td>Internal torque limit 1:
Set this parameter to limit servo motor-generated torque on the assumption that the maximum torque is 100[%].
When 0 is set, torque is not produced.
<table>
<tr><th>Across TL-SG</th><th>Torque Limit</th></tr>
<tr><td>Open</td><td>Internal torque limit 1 (Parameter No. 28)</td></tr>
<tr><td>Short</td><td>
<table>
<tr><th>Torque limit relationship</th><th>Valid torque limit</th></tr>
<tr><td>Analog torque limit < internal torque limit 1</td><td>Analog torque limit</td></tr>
<tr><td>Analog torque limit > internal torque limit 1</td><td>Internal torque limit 1</td></tr>
</table>
</td></tr>
</table>
</td><td>P·S</td></tr>
</table>

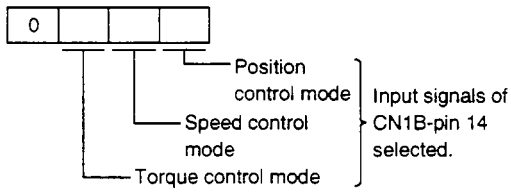
Class	No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode
Expansion parameters	29	VCO	Analog speed command offset: Used to set the offset voltage of the analog speed command (VC). When automatic VC offset is used, the automatically offset value is set to this parameter. The initial value is the value provided by the automatic VC offset function before shipment at the VC-LG voltage of 0V.	Depends on servo amplifier	mV	-999 to 999	S
			Analog speed limit offset: Used to set the offset voltage of the analog speed limit (VLA). When automatic VC offset is used, the auto-matically offset value is set to this parameter. The initial value is the value provided by the automatic VC offset function before shipment at the VLA-LG voltage of 0V.				T
	30	TLO	Analog torque command offset: Used to set the offset voltage of the analog torque command (TC).	0	mV	-999 to 999	T
			Analog torque limit offset: Used to set the offset voltage of the analog torque limit (TLA).				S
	31		Spare	0			
	32		Spare	0			
	33	MBR	Electromagnetic brake sequence output: Used to set the delay time (Tb) between electromagnetic brake operation and the base drive circuit is shut-off.	100	ms	0 to 1000	P·S·T
	34	GD2	Ratio of load inertia moment to servo motor inertia moment: Used to set the ratio of the load inertia moment to the servo motor shaft inertia moment. When auto tuning is selected, the result of auto tuning is auto-matically set.	70	×0.1 times	0 to 1000	P·S·T
	35	PG2	Position loop gain 2: Used to set the gain of the position loop. Set this parameter to increase the position response to level load disturbance. Higher setting increases the response level but is liable to generate vibration and/or noise. When auto tuning is selected, the result of auto tuning is automatically set.	30	rad/s	1 to 500	P
	36	VG1	Speed loop gain 1: Normally this parameter setting need not be changed. Higher setting increases the response level but is liable to generate vibration and/or noise. When auto tuning is selected, the result of auto tuning is automatically set.	216	rad/s	20 to 5000	P·S
	37	VG2	Speed loop gain 2: Set this parameter when vibration occurs on machines of low rigidity or large backlash. Higher setting increases the response level but is liable to generate vibration and/or noise. When auto tuning is selected, the result of auto tuning is automatically set.	714	rad/s	20 to 8000	P·S
	38	VIC	Speed integral compensation Used to set the integral time constant of the speed loop. When auto tuning is selected, the result of auto tuning is automatically set.	20	ms	1 to 1000	P·S

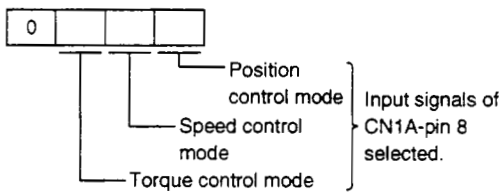
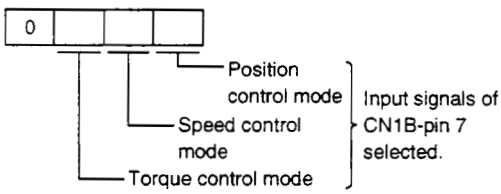
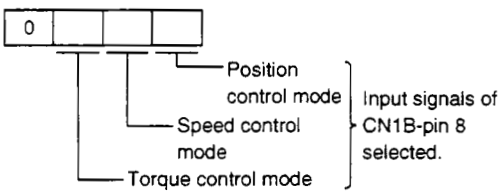
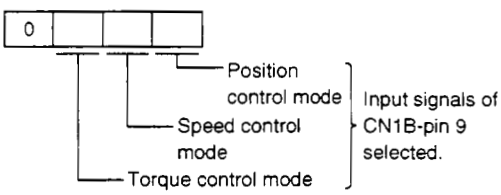
<table>
<tr><th>Class</th><th>No.</th><th>Symbol</th><th>Name and Function</th><th>Initial Value</th><th>Unit</th><th>Setting Range</th><th>Control Mode</th></tr>
<tr><td rowspan="4">Expansion parameters</td><td>39</td><td>VDC</td><td>Speed differential compensation:
Used to set the differential compensation.
Made valid when the proportion control signal is switched on.</td><td>980</td><td></td><td>0
to
1000</td><td>P · S</td></tr>
<tr><td>40</td><td></td><td>Spare</td><td>0</td><td></td><td></td><td></td></tr>
<tr><td>41</td><td>*DIA</td><td>Input signal automatic ON selection:
Used to set automatic ON of SON, LSP and LSN.

</td><td>0000</td><td></td><td>0000h
to
0111h</td><td>P · S · T
P · S</td></tr>
<tr><td>42</td><td>*DI1</td><td>Input signal selection 1:
Used to assign the control mode changing signal input pins and to set the clear signal.
 

<table>
<tr><th>Set Value</th><th>Connector Pin No.</th></tr>
<tr><td>0</td><td>CN1B-5</td></tr>
<tr><td>1</td><td>CN1B-14</td></tr>
<tr><td>2</td><td>CN1A-8</td></tr>
<tr><td>3</td><td>CN1B-7</td></tr>
<tr><td>4</td><td>CN1B-8</td></tr>
<tr><td>5</td><td>CN1B-9</td></tr>
</table></td><td>0003</td><td></td><td>0000h
to
0015h</td><td>
P/S
S/T
T/P
P · S · T</td></tr>
</table>

<table>
<tr><th>Class</th><th>No.</th><th>Symbol</th><th>Name and Function</th><th>Initial Value</th><th>Unit</th><th>Setting Range</th><th>Control Mode</th></tr>
<tr><td rowspan="2">Expansion parameters</td><td>43</td><td>*DI2</td><td>Input signal selection 2 (CN1B-pin 5):
This parameter is unavailable when parameter No. 42 is set to assign the control change signal (LOP) to CN1B-pin 5.
Allows any input signal to be assigned to CN1B-pin 5.
Note that the setting digit and assigned signal differ according to the control mode.
 

Signals that may be assigned in each control mode are indicated below by their symbols.
<table><tr><th rowspan="2">Set value</th><th colspan="3">(Note) Control Mode</th></tr><tr><th>P</th><th>S</th><th>T</th></tr><tr><td>0</td><td></td><td></td><td></td></tr><tr><td>1</td><td>SON</td><td>SON</td><td>SON</td></tr><tr><td>2</td><td>RES</td><td>RES</td><td>RES</td></tr><tr><td>3</td><td>PC</td><td>PC</td><td></td></tr><tr><td>4</td><td>TL</td><td>TL</td><td>TL</td></tr><tr><td>5</td><td>CR</td><td>CR</td><td>CR</td></tr><tr><td>6</td><td></td><td>SP1</td><td>SP1</td></tr><tr><td>7</td><td></td><td>SP2</td><td>SP2</td></tr><tr><td>8</td><td></td><td>ST1</td><td>RS2</td></tr><tr><td>9</td><td></td><td>ST2</td><td>RS1</td></tr></table>Note: P: Position control mode
S: Speed control mode
T: Torque control mode</td><td>0111</td><td></td><td>0000h
to
0999h</td><td>P · S · T</td></tr>
<tr><td>44</td><td>*DI3</td><td>Input signal selection 3 (CN1B-pin 14):
This parameter is unavailable when parameter No. 42 is set to assign the control change signal (LOP) to CN1B-pin 14.
Allows any input signal to be assigned to CN1B-pin 14.
The assignable signals and setting method are the same as in input signal selection 2 (parameter No. 43).
 
</td><td>0222</td><td></td><td>0000h
to
0999h</td><td>P · S · T</td></tr>
</table>

Class	No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode
Expansion parameters	45	*DI4	Input signal selection 4 (CN1A-pin 8): This parameter is unavailable when parameter No. 42 is set to assign the control change signal (LOP) to CN1 A-pin 8. Allows any input signal to be assigned to CN1A-pin 8. The assignable signals and setting method are the same as in input signal selection 2 (parameter No. 43). 	0665		0000h to 0999h	P · S · T
	46	*DI5	Input signal selection 5 (CN1B-pin 7): This parameter is unavailable when parameter No. 42 is set to assign the control change signal (LOP) to CN1 B-pin 7. Allows any input signal to be assigned to CN1B-pin 7. The assignable signals and setting method are the same as in input signal selection 2 (parameter No. 43). 	0770		0000h to 0999h	P · S · T
	47	*DI6	Input signal selection 6 (CN1B-pin 8): This parameter is unavailable when parameter No. 42 is set to assign the control change signal (LOP) to CN1B-pin 8. Allows any input signal to be assigned to CN1B-pin 8. The assignable signals and setting method are the same as in input signal selection 2 (parameter No. 43). 	0883		0000h to 0999h	P · S · T
	48	*DI7	Input signal selection 7 (CN1B-pin 9): This parameter is unavailable when parameter No. 42 is set to assign the control change signal (LOP) to CN1B-pin 9. Allows any input signal to be assigned to CN1B-pin 9. The assignable signals and setting method are the same as in input signal selection 2 (parameter No. 43). 	0994		0000h to 0999h	P · S · T

Class	No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode
Expansion parameters	49	*DO1	Output signal selection 1: Used to select the connector pins to output the alarm code and warning (WNG).	0000		0000h to 0051h	P · S · T

0	0		

Setting of alarm code output

Set Value	Connector Pins		
	CN1B-19	CN1A-18	CN1A-19
0	ZSP	INP or SA	RD
1	Alarm code is output at alarm occurrence.		

(Note) Alarm Code			Alarm Display	Name
CN1B pin 19	CN1A pin 18	CN1A pin 19		
0	0	0	8888	Watchdog
			A. 11	Board error 1
			A. 12	Memory error 1
			A. 13	Clock error
			A. 15	Memory error 2
			A. 17	Board error 2
			A. 18	Board error 3
			A. 37	Parameter error
			A. 8E	Serial communication error
0	0	1	A. 33	Overvoltage
0	1	0	A. 10	Undervoltage
0	1	1	A. 50	Overload 1
			A. 51	Overload 2
1	0	0	A. 24	Motor output ground fault
			A. 32	Overcurrent
1	0	1	A. 31	Overspeed
			A. 35	Command pulse error
			A. 52	Error excessive
1	1	0	A. 16	Encoder error 1
			A. 20	Encoder error 2

Note: 0:OFF
1:ON

Setting of warning (WNG) output
Select the connector pin to output warning. The old signal before selection will be unavailable.

Set Value	Connector Pin No.
0	Not output.
1	CN1A-19
2	CN1B-18
3	CN1A-18
4	CN1B-19
5	CN1B-6

5.2 Detailed Description

5.2.1 Electronic gear

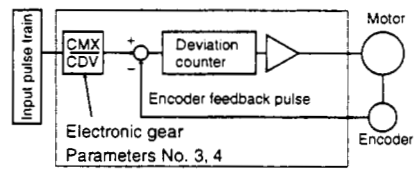
POINT

- The guideline of the electronic gear setting range is $\frac{1}{50} < \frac{CMX}{CDV} < 50$. If the set value is outside this range, noise may be generated during acceleration/deceleration or operation may not be performed at the preset speed and/or acceleration/deceleration time constants.

(1) Concept of electronic gear

The machine can be moved at any multiplication factor to input pulses.

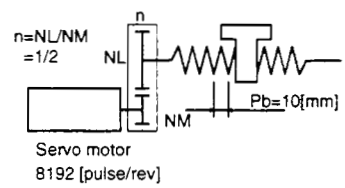
$$\frac{CMX}{CDV} = \frac{\text{Parameter No. 3}}{\text{Parameter No. 4}}$$



The following setting examples are used to explain how to calculate the electronic gear:

(a) For motion in increments of 10μm per pulse

Machine specifications



Ballscrew lead Pb =10 [mm]
Reduction ratio: n = 1/2
Servo motor resolution: Pt = 8192 [pulses/rev]

$$\frac{CMX}{CDV} = \Delta\ell o \cdot \frac{Pt}{\Delta S} = \Delta\ell o \cdot \frac{Pt}{n \cdot Pb} 10\times10^{-3} \cdot \frac{8192}{1/2 \cdot 10} = \frac{16384}{1000} = \frac{2048}{125}$$

Hence, set 2048 to CMX and 125 to CDV.

(b) Conveyor setting example

For rotation in increments of 0.01° per pulse

Machine specifications

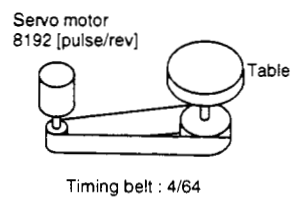


Table resolution: 36000 pulses/rev
Reduction ratio: n = 4/64
Servo motor resolution: Pt = 8192 [pulses/rev]

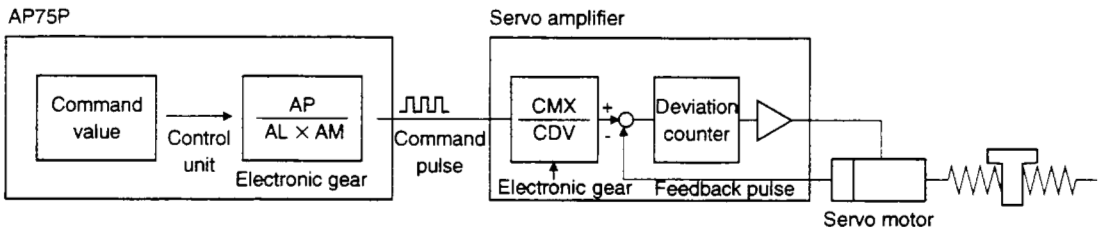
$$\frac{CMX}{CDV} = \frac{Pt}{\Delta S} = \frac{Pt}{36000\times4/64} = \frac{131072}{36000} = \frac{4096}{1125}$$

Reduce CDV to 32767 or less and round off the result to the units.
Hence, set 4096 to CMX and 1125 to CDV.

(2) Setting for use of AD75P

The AD75P also has the following electronic gear parameters. Normally, the servo amplifier side electronic gear must also be set due to the restriction on the command pulse frequency (differential 500kpps, open collector 200kpps).

AP: Number of pulses per motor revolution
AL: Moving distance per motor revolution
AM: Unit scale factor



Electronic gear setting example for use of AD75P

Rated Servo Motor Speed				3000r/min	
Servo amplifier	Input system			Open collector	Differential line driver
	Max. input pulse frequency			200kpps	500kpps
	Feedback pulse/revolution			8192pulse/rev	
	Electronic gear (CMX/CDV)			125/256	1/1
AD75P	Command pulse frequency (Note 1)			200kpps	409.6kpps
	Number of pulses per servo motor revolution as viewed from AD75P			4000pulse/rev	8192pulse/rev
	Electronic gear	Minimum command unit 1pulse	AP	1	1(Note 2)
			AL	1	1(Note 2)
			AM	1	1(Note 2)
		Minimum command unit 0.1μm(Note 3)	AP	4000	8192
			AL	1000	1000
			AM	100	100

Note: 1. Command pulse frequency at rated speed

2. Assuming that AP=8192 and AL=8000, the command unit amount per motor revolution is 8000 pulses/rev, which makes positioning data setting easier.

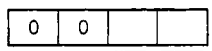
3. In the case where the ballscrew lead is 10mm.

5.2.2 Changing the status display screen

The status display item of the servo amplifier display shown at power-on can be changed by changing the parameter No. 18 settings.
The item displayed in the initial status changes with the control mode as follows:

Control Mode	Displayed Item
Position control mode	Cumulative feedback pulses
Speed control mode	Motor speed
Torque control mode	Torque command voltage

For display details, refer to Section 6.2.



Selection of status display at power-on
0: Cumulative feedback pulses
1: Servo motor speed
2: Droop pulses
3: Cumulative command pulses
4: Command pulse frequency
5: Analog speed command voltage (Note 1)
6: Analog torque command voltage (Note 2)
7: Regenerative load ratio
8: Effective load ratio
9: Peak load ratio
A: Within one-revolution position
B: ABS counter
C: Load inertia moment ratio

Note: 1. In speed control mode. Analog speed limit voltage in torque control mode.
2. In torque control mode. Analog torque limit voltage in speed or position control mode.

Status display at power-on in corresponding control mode
0: Depends on the control mode.

Control Mode	Status Display at Power-On
Position	Cumulative feedback pulses
Position/speed	Cumulative feedback pulses/servo motor speed
Speed	Servo motor speed
Speed/torque	Servo motor speed/analog torque command voltage
Torque	Analog torque command voltage
Torque/position	Analog torque command voltage/cumulative feedback pulses

1: Depends on the first digit setting of this parameter.

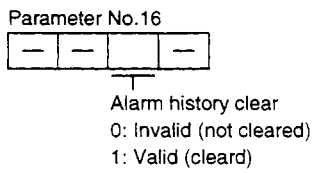
5.2.3 Using forward/reverse rotation stroke end to change the stopping pattern

The stopping pattern is factory-set to make a sudden stop when the forward/reverse rotation stroke end is made valid. A slow stop can be made by changing the parameter No. 22 value.

Parameter No.22 Setting	Stopping Method
□□□0 (initial value)	Sudden stop Droop pulses are reset to make a stop.
□□□1	Slow stop Position control mode : The motor is decelerated to a stop in accordance with the parameter No. 7 value. Speed control mode : The motor is decelerated to a stop in accordance with the parameter No. 12 value.

5.2.4 Alarm history clear

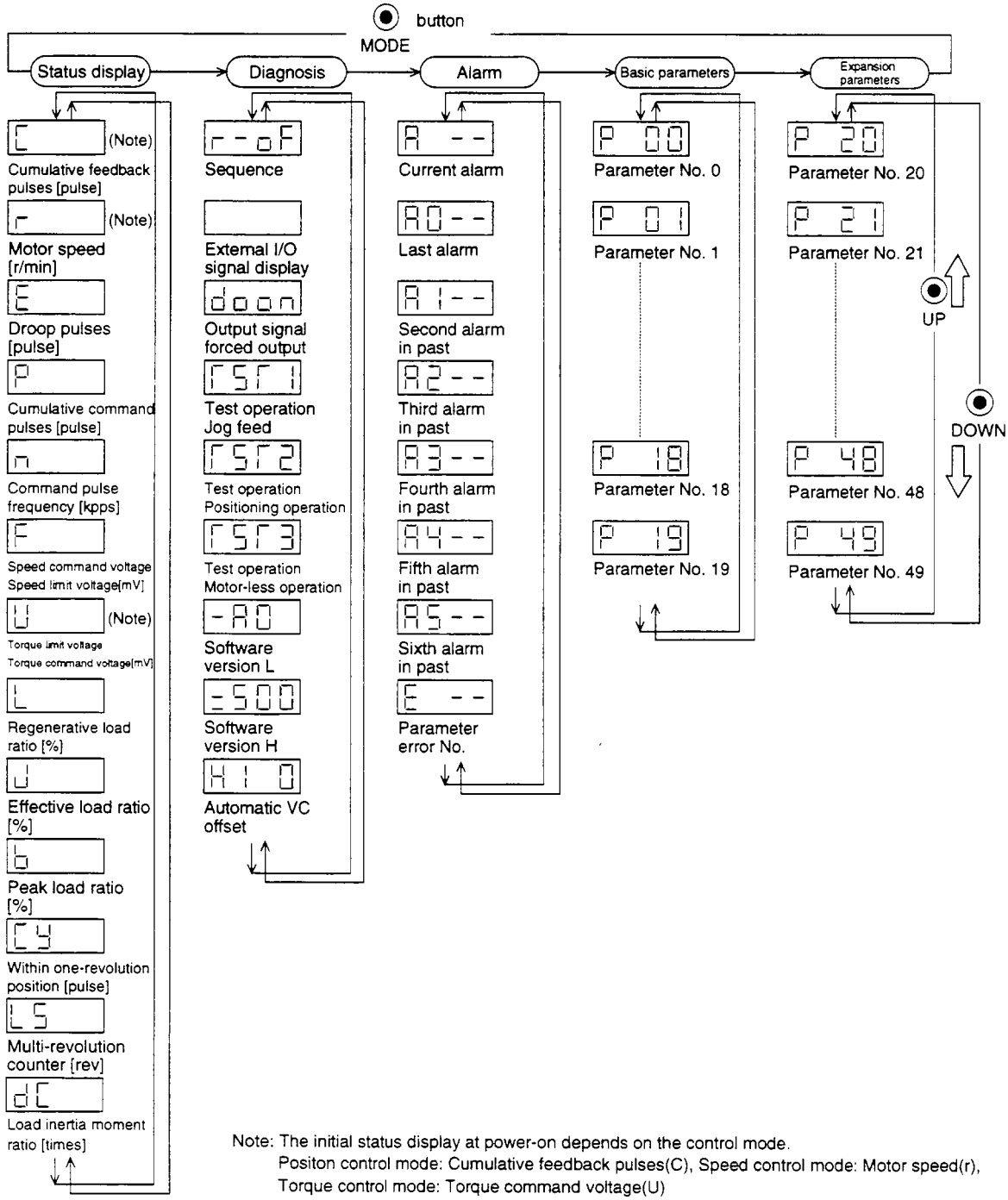
The servo amplifier stores one current alarm and five past alarms from when its power is switched on first. To control alarms which will occur during operation, clear the alarm history using parameter No.16 before starting operation.



6. DISPLAY AND OPERATION

6.1 Display Flowchart

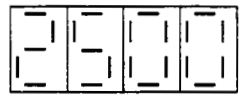
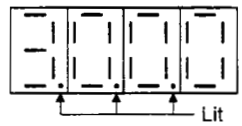
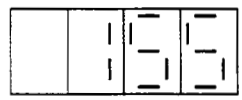
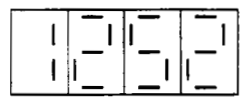
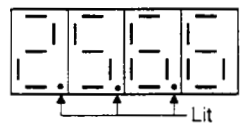
Use the display (4-digit, 7-segment LED) on the front panel of the servo amplifier for status display, parameter setting, etc. Set the parameters before operation, diagnose an alarm, confirm external sequences, and/or confirm the operation status. Press the "MODE" "UP" or "DOWN" button once to move to the next screen.
To refer to or set the expansion parameters, make them valid with parameter No. 19 (parameter write disable).



Note: The initial status display at power-on depends on the control mode.
Positon control mode: Cumulative feedback pulses(C), Speed control mode: Motor speed(r),
Torque control mode: Torque command voltage(U)

6.2 Status Display

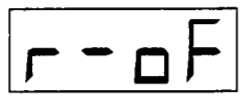
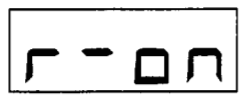
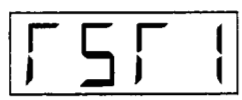
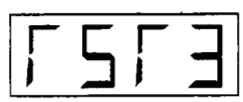
The servo status during operation is shown on the 4-digit, 7-segment LED display. Press the "UP or "DOWN" button to change display data as desired. When the required data is selected, the corresponding symbol appears. Press the "SET" button to display its data.
The servo amplifier display shows the lower four digits of 13 data items such as the motor speed.
The following table lists display examples:

Item	Status	Displayed Data Servo amplifier display
Motor speed	Forward rotation at 3000r/min	
	Reverse rotation at 3000r/min	 Reverse rotation is indicated by the lit decimal points in the upper three digits.
Load inertia moment	15.5 times	 Value of ×0.1 times is shown.
Multi-revolution counter	11252pulse	
	-12566pulse	 Negative value is indicated by the lit decimal points in the upper three digits.

The following table lists the servo statuses that may be shown:

Name	Symbol	Unit	Description	Display Range
Cumulative feedback pulses	C	pulse	Feedback pulses from the servo motor encoder are counted and displayed. The value in excess of ±9999 is counted, bus since the servo amplifier display is four digits, it shows the lower four digits of the actual value. Press the "SET" button to reset the display value to zero.	-9999 to 9999
Servo motor speed	r	r/min	The servo motor speed is displayed. When the servo motor is rotating in the reverse direction, the decimal points in the upper 3 digits are lit. The value rounded off is displayed in ×0.1r/min.	-6000 to 6000
Droop pulses	E	pulse	The number of droop pulses in the deviation counter is displayed. When the servo motor is rotating in the reverse direction, the decimal points in the upper 3 digits are lit. Since the servo amplifier display is four digits, it shows the lower four digits of the actual value.	-9999 to 9999
Cumulative command pulses	P	pulse	The position command input pulses are counted and displayed. As the value displayed is not multiplied by the electronic gear, it may not match the indication of the cumulative feedback pulses. The value in excess of ±9999 is counted, but since the servo amplifier display is four digits, it shows the lower four digits of the actual value. Press the "SET" button to reset the display value to zero. When the servo motor is rotating in the reverse direction, the decimal points in the upper 3 digits are lit.	-9999 to 9999
Command pulse frequency	n	kpps	The frequency of the position command input pulses is displayed. The value displayed is not multiplied by the electronic gear. When the servo motor is rotating in the reverse direction, the decimal points in the upper 3 digits are lit.	-500 to 500
Analog speed command voltage Analog speed limit voltage	F	V	(1)Torque control mode Analog speed limit (VLA) voltage is displayed. (2)Speed control mode Analog speed command (VC) voltage is displayed.	-10.00 to 10.00
Analog torque command voltage Analog torque limit voltage	U	V	(1)Position control mode, speed control mode Reverse rotation analog torque limit (TLA) voltage is displayed. Indication range: -10 to +10V. (2)Torque control mode Reverse rotation analog torque command (TLA) voltage is displayed. Indication range: 0 to +10V	Refer to the Descrip-tion column.
Regenerative load ratio	L	%	The ratio of regenerative power to permissible regenerative power is displayed in %.	0 to 100
Effective load ratio	J	%	The continuous effective load torque is displayed. The effective value is displayed relative to the rated torque of 100%.	0 to 300
Peak load ratio	b	%	The maximum torque generated during acceleration/deceleration, etc. The highest value in the past 15 seconds is displayed relative to the rated torque of 100%.	0 to 400
Within one-revolution position	Cy	pulse	Position within one revolution is displayed in encoder pulses. The value returns to 0 when it exceeds the maximum number of pulses.	0 to 8191
Multi-revolution counter	LS	rev	The value of the multi-revolution counter is displayed. Since the servo amplifier display is four digits, it shows the lower four digits of the actual value.	-32768 to 32767
Load inertia moment ratio	dc	0.1 Times	The estimated ratio of the load inertia moment to the servo motor shaft inertia moment is displayed.	0 to 1000

6.3 Diagnostic mode

Name		Display	Description
Sequence			Not ready. Indicates that the servo amplifier is being initialized or an alarm has occurred.
			Ready. Indicates that the servo was switched on after completion of initialization and the servo amplifier is ready to operate.
External I/O signal display		Refer to section 6.6.	Indicates the ON-OFF states of the external I/O signals. The upper segments correspond to the input signals and the lower segments to the output signals. Lit: ON Extinguished: OFF The I/O signals can be changed using parameters No. 43 to 49.
Output signal forced output			The digital output signal can be forced on/off. For more information, refer to section 6.7.
Test operation mode	Jog feed		Jog operation can be performed when there is no command from the external command device. For details, refer to section 6.8.2
	Positioning operation		The servo configuration software (MRZJW3-SETUP61E) is required for positioning operation. This operation cannot be performed from the operation section of the servo amplifier. Positioning operation can be performed once when there is no command from the external command device.
	Motorless operation		Without connection of the servo motor, the servo amplifier provides output signals and displays the status as if the servo motor is running actually in response to the external input signal. For details, refer to section 6.8.4.
Software version Low			Indicates the version of the software.
Software version High			Indicates the system number of the software.
Automatic VC offset			If offset voltages in the analog circuits inside and outside the servo amplifier cause the servo motor to rotate slowly at the analog speed command (VC) or analog speed limit (VLA) of 0V, this function automatically makes zero-adjustment of offset voltages. When using this function, make it valid in the following procedure. Making it valid causes the parameter No. 29 value to be the automatically adjusted offset voltage. 1) Press "SET" once. 2) Choose 1 with "UP"/"DOWN". 3) Press "SET".

6.4 Alarm mode

The current alarm, past alarm history and parameter error are displayed. The lower 2 digits on the display indicate the alarm number that has occurred or the parameter number in error. Display examples are shown below.

Name	Display	Description
Current alarm	A ---	Indicates no occurrence of an alarm.
	A. 33	Indicates the occurrence of alarm 33 (overvoltage). Flickers at occurrence of the alarm.
Alarm history	A050	Indicates that the last alarm is alarm 50 (overload 1).
	A133	Indicates that the second alarm in the past is alarm 33 (overvoltage).
	A2 10	Indicates that the third alarm in the past is alarm 10 (undervoltage).
	A331	Indicates that the fourth alarm in the past is alarm 31 (overspeed).
	A4--	Indicates that there is no fifth alarm in the past.
	A5--	Indicates that there is no sixth alarm in the past.
Parameter error	E. ---	Indicates no occurrence of alarm 37 (parameter error).
	E. 01	Indicates that the data of parameter No. 1 is faulty.

Functions at occurrence of an alarm

(1) Any mode screen displays the current alarm.

(2) The other screen is visible during occurrence of an alarm. At this time, the decimal point in the fourth digit flickers.

(3) For any alarm, remove its cause and clear it in any of the following methods:
   (a) Switch power OFF, then ON.
   (b) Press the "SET" button on the current alarm screen.
   (c) Turn on the alarm reset (RES) signal (for clearable alarms, refer to Section 9.2.1).

(4) Use parameter No. 16 to clear the alarm history.

6.5 Parameter mode

The servo amplifier is factory-set in the position control mode. Change the parameter settings when:

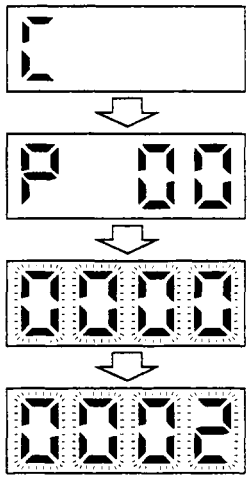
- The control mode is changed;
- The number of pulses per servo motor revolution is changed; or
- The machine mounted with the servo motor hunts or operational performance is further improved.

Some parameters are made valid by changing the setting and then switching power off once and switching it on again. (Refer to Section 5.1.2.)

(1) Operation example

(a) 4-digit parameter

The following example shows the operation procedure performed after power-on to change the control mode (parameter No. 0) to the speed control mode.



Press MODE three times.
..... The parameter number is displayed.
Press UP or DOWN to change the number.
Press SET twice.
..... The set value of the specified parameter number flickers.
Press UP once.
..... During flickering, the set value can be changed.
Use UP or DOWN.
(□□□2: Speed control mode)
Press SET to enter.

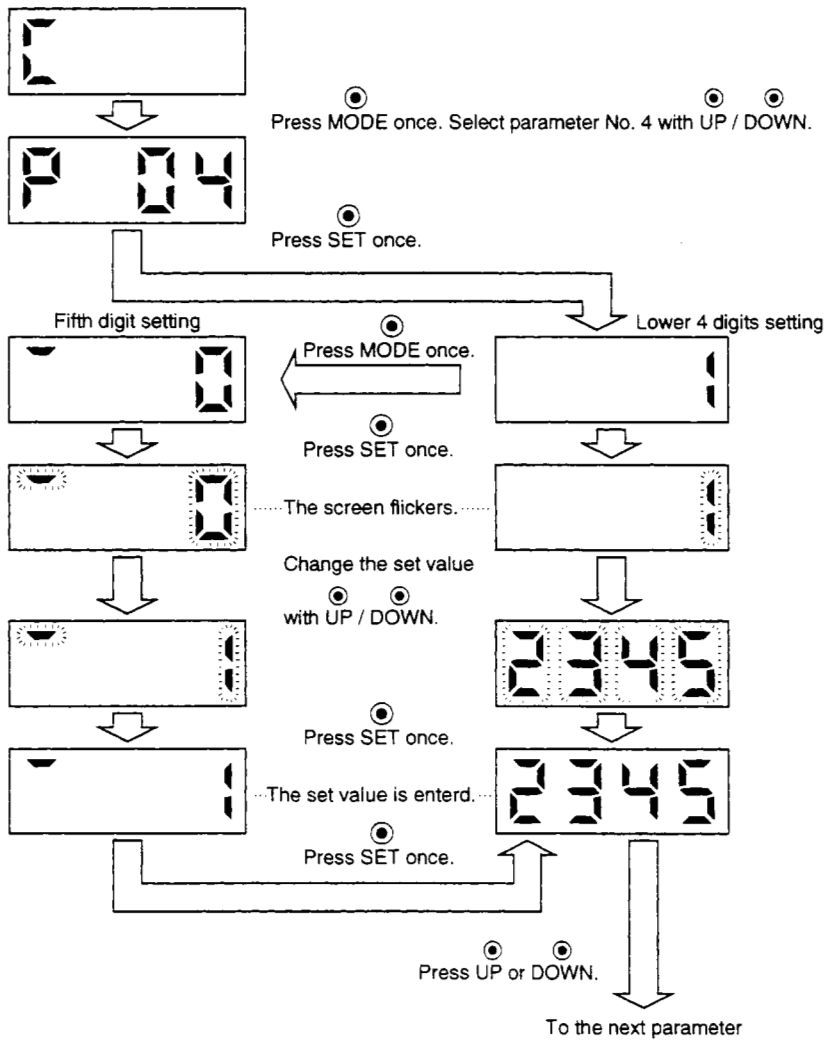
To shift to the next parameter, press the UP / DOWN button.

When changing the parameter No. 0 setting, change its set value, then switch power off once and switch it on again to make the new value valid.

(b) 5-digit parameter

The following example shows the operation procedure performed to change the electronic gear denominator (parameter No. 4) into "12345":

Call the display screen shown after power-on.


Press MODE once. Select parameter No. 4 with UP / DOWN.
Press SET once.
Fifth digit setting
Lower 4 digits setting
Press MODE once.
Press SET once.
The screen flickers.
Change the set value
with UP / DOWN.
Press SET once.
The set value is enterd.
Press SET once.
Press UP or DOWN.
To the next parameter

(2) Expansion parameters

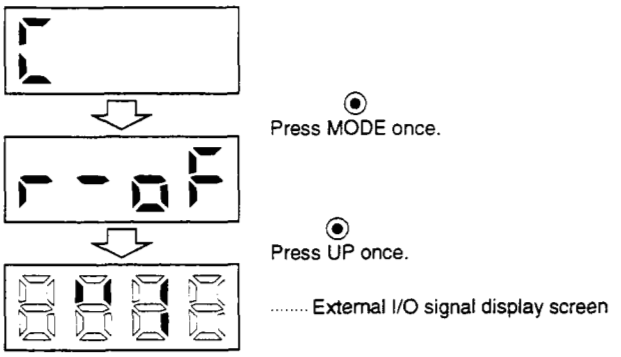
To use the expansion parameters, change the setting of parameter No. 19 (parameter write disable). Refer to section 5.1.1.

6.6 External I/O signal display

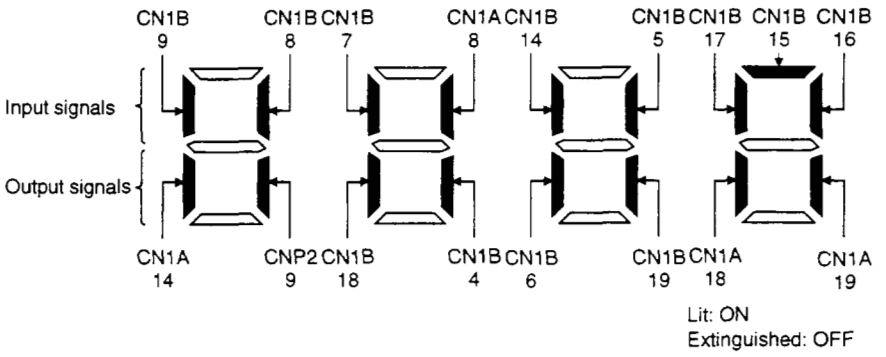
The ON/OFF states of the digital I/O signals connected to the servo amplifier can be confirmed.

(1) Operation

Call the display screen shown after power-on.



(2) Display definition



The 7-segment LED shown above indicates ON/OFF.
Each segment at top indicates the input signal and each segment at bottom indicates the output signal.
The signals corresponding to the pins in the respective control modes are indicated below:

(a) Control modes and I/O signals

Connector	Pin No.	Signal Input/Output (Note 1) I/O	(Note 2) Symbols of I/O Signals in Control Modes					
			P	P/S	S	S/T	T	T/P
CN1A	8	I	CR	CR/SP1	(Note 3) SP1	SP1	(Note 3) SP1	SP1/CR
	14	O	OP	OP	OP	OP	OP	OP
	(Note 6, 8) 18	O	INP	INP/SA	SA	SA/—		— /INP
	(Note 8) 19	O	RD	RD	RD	RD	RD	RD
CN1B	(Note 9) 4	O	DO1	DO1	DO1	DO1	DO1	DO1
	(Note 7) 5	I	SON	SON	SON	SON	SON	SON
	(Note 6) 6	O	TLC	TLC	TLC	TLC/VLC	VLC	VLC/TLC
	(Note 7) 7	I		LOP	SP2	LOP	SP2	LOP
	(Note 7) 8	I	PC	PC/ST1	(Note 4) ST1	ST1/RS2	(Note 4) RS2	RS2/PC
	(Note 7) 9	I	TL	TL/ST2	(Note 5) ST2	ST2/RS1	(Note 5) RS1	RS1/TL
	(Note 7) 14	I	RES	RES	RES	RES	RES	RES
	15	I	EMG	EMG	EMG	EMG	EMG	EMG
	16	I	LSP	LSP	LSP	LSP/—		— /LSP
	17	I	LSN	LSN	LSN	LSN/—		— /LSN
	(Note 6) 18	O	ALM	ALM	ALM	ALM	ALM	ALM
	(Note 6, 8) 19	O	ZSP	ZSP	ZSP	ZSP	ZSP	ZSP
CNP2	9	O	B1	B1	B1	B1	B1	B1

Note: 1. I : Input signal, O: Output signal

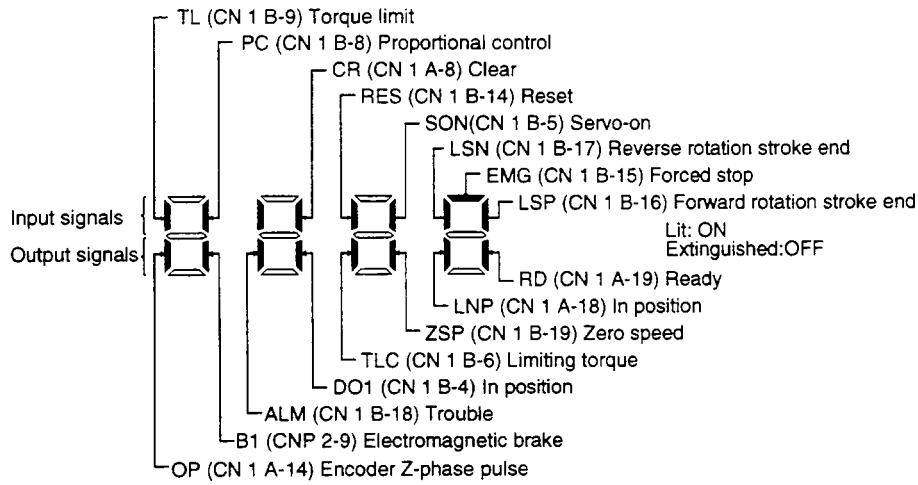
2. P : Position control mode, S: Speed control mode, T: Torque control mode, P/S: Position/speed control change mode, S/T: Speed/torque control change mode, T/P: Torque/position control change mode
3. Set parameter No. 45 to use CR.
4. Set parameter No. 47 to use PC.
5. Set parameter No. 48 to use TL.
6. Set parameter No. 49 to use WNG.
7. Set parameters No. 43 to 48 to change signals.
8. Set parameter No. 49 to output the alarm code. (Refer to Section 9.2.1.)
9. The signal of CN1A-18 is always output.

(b) Symbol and signal names

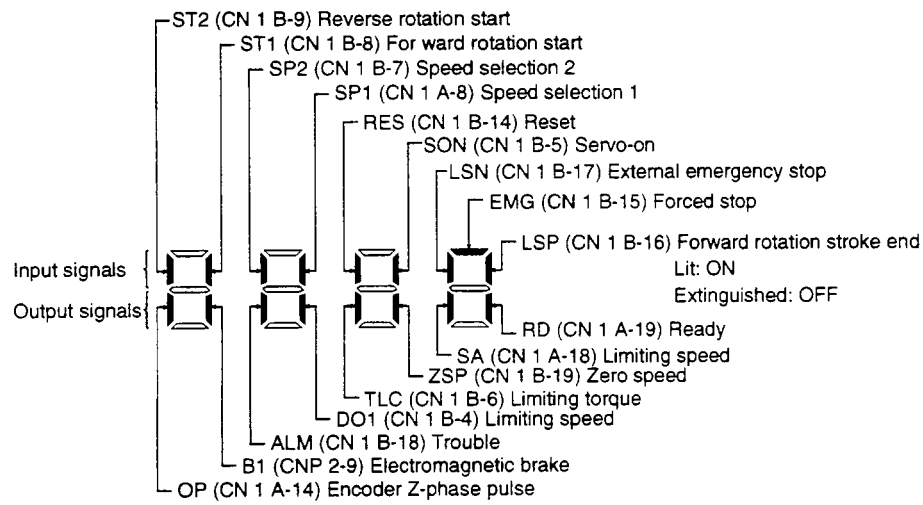
Symbol	Signal Name	Symbol	Signal Name
SON	Servo-on	EMG	Forced stop
LSP	Forward rotation stroke end	LOP	Control change
LSN	Reverse rotation stroke end	TLC	Limiting torque
CR	Clear	VLC	Limiting speed
SP1	Speed selection 1	RD	Ready
SP2	Speed selection 2	ZSP	Zero speed
PC	Proportion control	INP	In position
ST1	Forward rotation start	SA	Speed reached
ST2	Reverse rotation start	ALM	Trouble
RS1	Forward rotation selection	WNG	Warning
RS2	Reverse rotation selection	OP	Encoder Z-phase pulse (open collector)
TL	Torque limit	B1	Electromagnetic brake
RES	Reset		

(3) Default signal indications

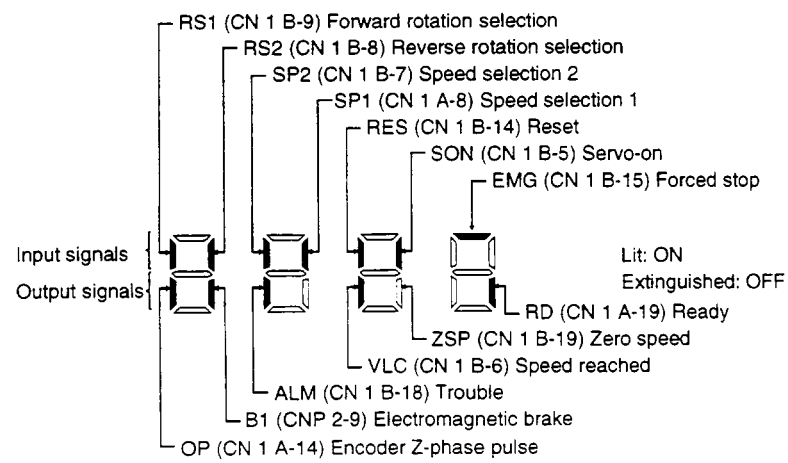
(a) Position control mode


TL (CN 1 B-9) Torque limit
PC (CN 1 B-8) Proportional control
CR (CN 1 A-8) Clear
RES (CN 1 B-14) Reset
SON(CN 1 B-5) Servo-on
LSN (CN 1 B-17) Reverse rotation stroke end
EMG (CN 1 B-15) Forced stop
LSP (CN 1 B-16) Forward rotation stroke end
Lit: ON
Extinguished:OFF
Input signals
Output signals
RD (CN 1 A-19) Ready
LNP (CN 1 A-18) In position
ZSP (CN 1 B-19) Zero speed
TLC (CN 1 B-6) Limiting torque
DO1 (CN 1 B-4) In position
ALM (CN 1 B-18) Trouble
B1 (CNP 2-9) Electromagnetic brake
OP (CN 1 A-14) Encoder Z-phase pulse

(b) Speed control mode


ST2 (CN 1 B-9) Reverse rotation start
ST1 (CN 1 B-8) For ward rotation start
SP2 (CN 1 B-7) Speed selection 2
SP1 (CN 1 A-8) Speed selection 1
RES (CN 1 B-14) Reset
SON (CN 1 B-5) Servo-on
LSN (CN 1 B-17) External emergency stop
EMG (CN 1 B-15) Forced stop
LSP (CN 1 B-16) Forward rotation stroke end
Lit: ON
Extinguished: OFF
Input signals
Output signals
RD (CN 1 A-19) Ready
SA (CN 1 A-18) Limiting speed
ZSP (CN 1 B-19) Zero speed
TLC (CN 1 B-6) Limiting torque
DO1 (CN 1 B-4) Limiting speed
ALM (CN 1 B-18) Trouble
B1 (CNP 2-9) Electromagnetic brake
OP (CN 1 A-14) Encoder Z-phase pulse

(c) Torque control mode


RS1 (CN 1 B-9) Forward rotation selection
RS2 (CN 1 B-8) Reverse rotation selection
SP2 (CN 1 B-7) Speed selection 2
SP1 (CN 1 A-8) Speed selection 1
RES (CN 1 B-14) Reset
SON (CN 1 B-5) Servo-on
EMG (CN 1 B-15) Forced stop
Lit: ON
Extinguished: OFF
Input signals
Output signals
RD (CN 1 A-19) Ready
ZSP (CN 1 B-19) Zero speed
VLC (CN 1 B-6) Speed reached
ALM (CN 1 B-18) Trouble
B1 (CNP 2-9) Electromagnetic brake
OP (CN 1 A-14) Encoder Z-phase pulse

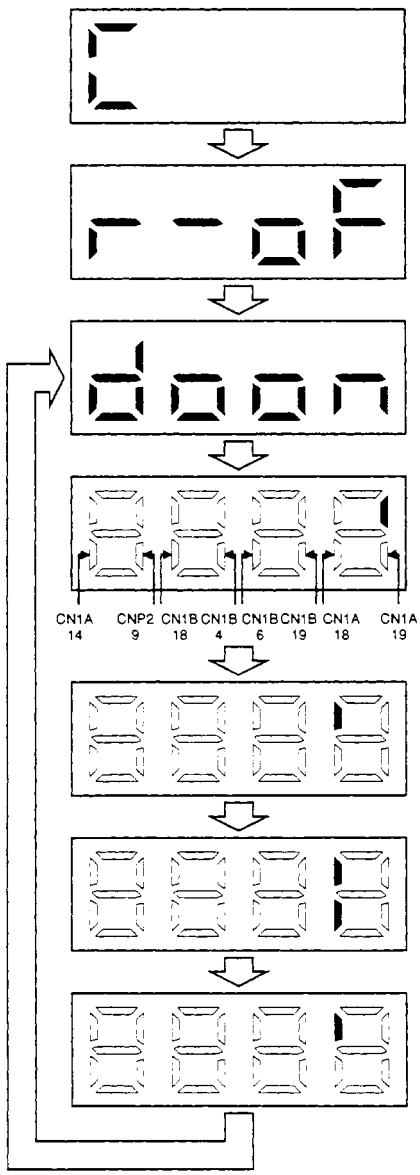
6.7 Output signal forced output (DO forced output)

> **POINT**
>
> • When the servo system is used in a vertical lift application, turning off CNP2-9 (electromagnetic brake) will release the electromagnetic brake, causing a drop. Take drop preventive measures on the machine side.

The output signal can be forced on/off independently of the servo status. This function is used for output signal wiring check, etc. This operation must be performed in the servo off state (SON signal off).

Operation

Call the display screen shown after power-on.



Press MODE once.

Press UP twice.

Press SET for more than 2 seconds.

..... Switch on/off the signal below the lit segment.

..... Indicates the ON/OFF of the output singal. The correspondences between segments and signals are as in the output signals of the external I/O signal display.
(Lit: ON, extinguished: OFF)

Press MODE once.

..... The segment above CN1A-pin 18 is lit.

Press UP once.

..... CN1A-pin 18 is switched on.
(CN1A-pin 18-SG conduct.)

Press DOWN once.

..... CN1A-pin 18 is switched off.

Press SET for more than 2 seconds.

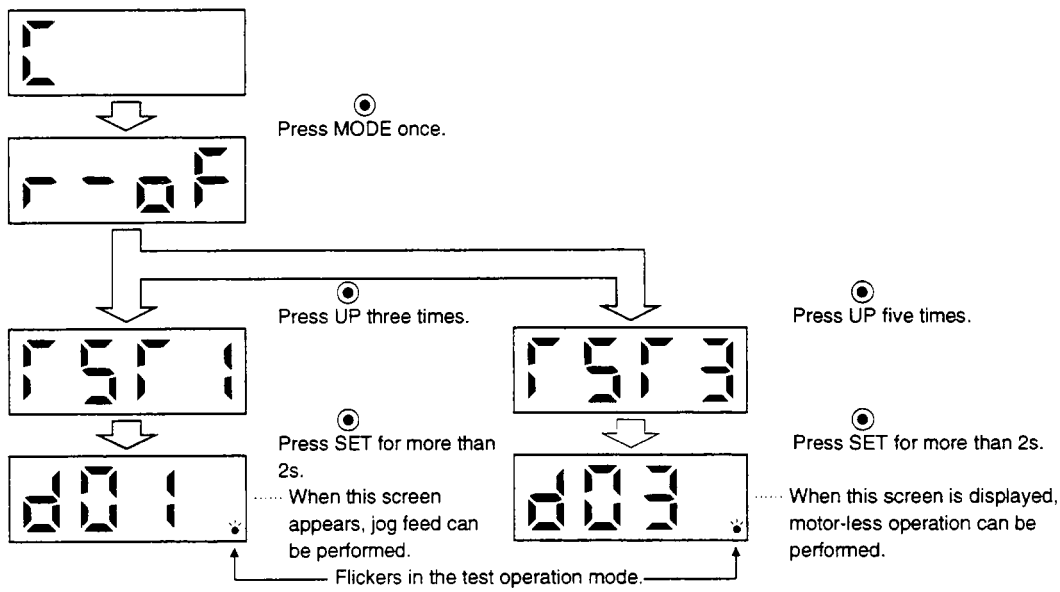
6.8 Test operation mode

> **⚠ CAUTION**
>
> - The test operation mode is designed to confirm servo operation and not to confirm machine operation. In this mode, do not use the servo motor with the machine.
> - If any operational fault has occurred, stop operation using the forced stop (EMG) signal.

> **POINT**
>
> - The Servo Configuration software is required to perform positioning operation.

6.8.1 Mode change

Call the display screen shown after power-on. Choose jog operation/motor-less operation in the following procedure:


Press MODE once.
Press UP three times.
Press UP five times.
Press SET for more than 2s.
When this screen appears, jog feed can be performed.
Press SET for more than 2s.
When this screen is displayed, motor-less operation can be performed.
Flickers in the test operation mode.

6.8.2 Jog operation

Jog operation can be performed when there is no command from the external command device.

(1) Operation

Connect EMG-SG to start jog operation and connect VDD-COM to use the internal power supply.
Hold down the "UP" or "DOWN" button to run the servo motor. Release it to stop. When using the Servo Configuration software, you can change the operation conditions. The initial conditions and setting ranges for operation are listed below:

Item	Initial Setting	Setting Range
Speed [r/min]	200	0 to instantaneous permissible speed
Acceleration/deceleration time constant [ms]	1000	0 to 50000

How to use the buttons is explained below:

Button	Description
"UP"	Press to start CCW rotation. Release to stop.
"DOWN"	Press to start CW rotation. Release to stop.

If the communication cable is disconnected during jog operation performed by using the Servo Configuration software, the servo motor will be decelerated to a stop.

(2) Status display

You can confirm the servo status during jog operation.
Pressing the "MODE" button in the jog operation-ready status calls the status display screen. With this screen being shown, perform jog operation with the "UP" or "DOWN" button. Every time you press the "MODE" button, the next status display screen appears, and on completion of a screen cycle, pressing that button returns to the jog operation-ready status screen. For full information of the status display, refer to Section 6.2. In the test operation mode, you cannot use the "UP" and "DOWN" buttons to change the status display screen from one to another.

(3) Termination of jog operation

To end the jog operation, switch power off once or press the "MODE" button to switch to the next screen and then hold down the "SET" button for 2 or more seconds.

6.8.3 Positioning operation

POINT
• The Servo Configuration software is required to perform positioning operation.

Positioning operation can be performed once when there is no command from the external command device.

(1) Operation

Connect EMG-SG to start positioning operation and connect VDD-COM to use the internal power supply.

Pressing the "Forward" or "Reverse" button on the Servo Configuration software starts the servo motor, which will then stop after moving the preset travel distance. You can change the operation conditions on the Servo Configuration software. The initial conditions and setting ranges for operation are listed below:

Item	Initial Setting	Setting Range
Travel distance [pulse]	10000	0 to 9999999
Speed [r/min]	200	0 to instantaneous permissible speed
Acceleration/deceleration time constant [ms]	1000	0 to 50000

How to use the keys is explained below:

Key	Description
"Forward"	Press to start positioning operation CCW.
"Reverse"	Press to start positioning operation CW.
"Pause"	Press during operation to make a temporary stop. Pressing the "Pause" button again erases the remaining distance. To resume operation, press the button that was pressed to start the operation.

If the communication cable is disconnected during positioning operation, the servo motor will come to a sudden stop.

(2) Status display

You can monitor the status display even during positioning operation.

6.8.4 Motor-less operation

Without connecting the servo motor, you can provide output signals or monitor the status display as if the servo motor is running in response to external input signals. This operation can be used to check the sequence of a host programmable controller or the like.

(1) Operation

After turning off the signal across SON-SG, choose motor-less operation. After that, perform external operation as in ordinary operation.

(2) Status display

You can confirm the servo status during motor-less operation.

Pressing the "MODE" button in the motor-less operation-ready status calls the status display screen. With this screen being shown, perform motor-less operation. Every time you press the "MODE" button, the next status display screen appears, and on completion of a screen cycle, pressing that button returns to the motor-less operation-ready status screen. For full information of the status display, refer to Section 6.2. In the test operation mode, you cannot use the "UP" and "DOWN" buttons to change the status display screen from one to another.

(3) Termination of motor-less operation

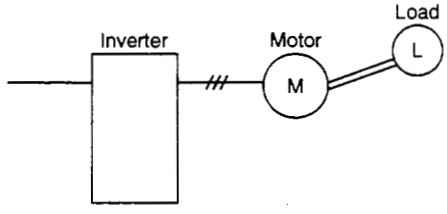
To terminate the motor-less operation, switch power off.

7. ADJUSTMENT

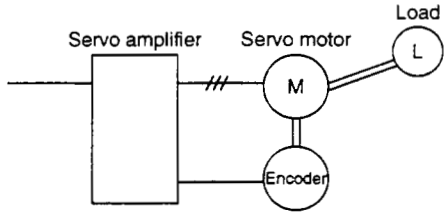
7.1 What Is Gain Adjustment?

7.1.1 Difference between servo amplifier and other drives

Besides the servo amplifier, there are other motor drives such as an inverter and stepping driver. Among these drives, the servo amplifier requires gain adjustment.
The inverter and stepping driver are in an open loop (actual motor speed and position are not detected on the driver side).

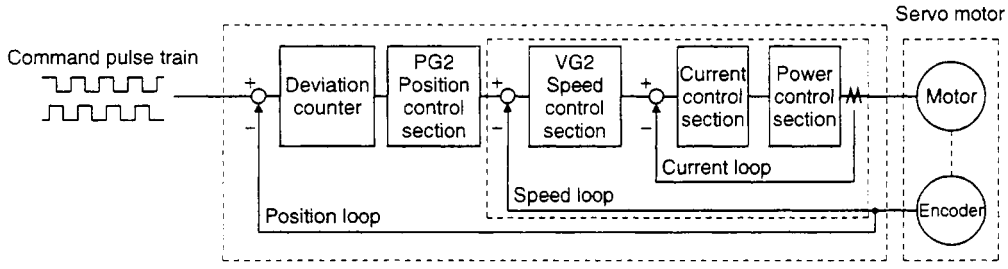


On the other hand, the servo amplifier always detects the positions and speeds of the motor and machine using the servo motor encoder, and exercises control to match the position and speed commands with the actual motor (machine) position and speed. In the servo system, adjustment is needed because:



(1) Response changes according to the inertia moment of the machine;
(2) Vibration occurs due to the resonance point, etc. peculiar to the machine; and
(3) Operation delay and accuracy specification differ between machines and response should satisfy this specification.

7.1.2 Basics of the servo system



A general servo system configuration is shown above. The servo control system consists of three loops: current loop, speed loop and position loop. Among these three loops, the response of the inside loop must be increased 4 to 6 times higher. If this condition is not satisfied, vibration will be generated. If the condition further worsens, hunting will occur.

(1) Current loop

For this servo amplifier, the response level of the current loop is factory-set to a high value and need not be adjusted. If the motor is installed to the machine, the response of the current loop will hardly vary.

(2) Speed loop

Response will vary according to the inertia moment of the machine. When the load inertia moment increases, the response of the speed loop will reduce. Use the speed loop gain (VG2) to compensate for the reduction of the response level.

$$\text{Speed loop response } f_V[\text{rad/s}] = \frac{\text{Amplifier gain settig VG2 [rad/s]}}{1+m}$$

$$\text{m: Load inertia moment ratio} \left[= \frac{J_L}{J_M} \right]$$

J_L = load inertia moment

J_M = servo motor shaft inertia moment

(3) Position loop

The response level will not vary according to machine conditions.

Position loop response f_P [rad/s] = amplifier gain setting PG2 [rad/s]

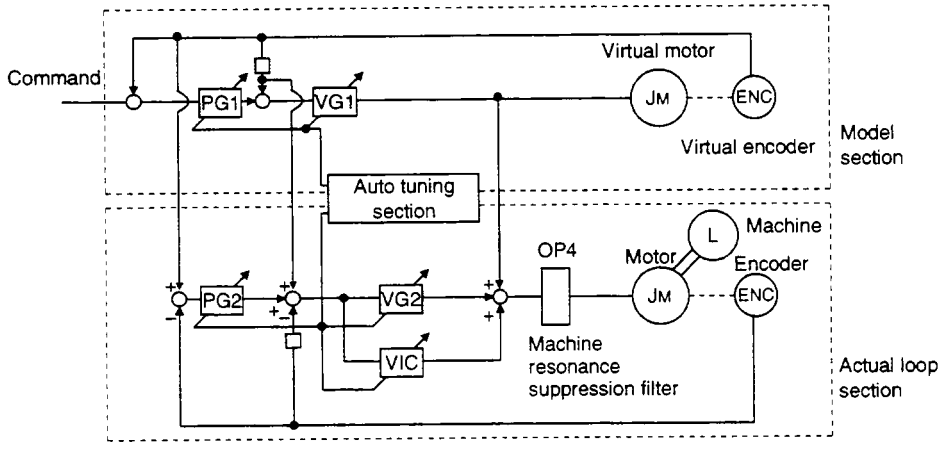
When the motor is installed to the machine, the gain must be adjusted to satisfy f_V = 4 to 6f_P according to the load inertia moment ratio m.

7.2 Gain Adjustment

7.2.1 Parameters required for gain adjustment

Parameter No.	Symbol	Name
No. 2	ATU	Auto tuning
No. 6	PG1	Position loop gain 1
No. 22	*OP4	Function selection 4 (machine resonance filter)
No. 34	GD2	Ratio of load inertia moment to motor inertia moment
No. 35	PG2	Position loop gain 2
No. 36	VG1	Speed loop gain 1
No. 37	VG2	Speed loop gain 2
No. 38	VIC	Speed integral compensation

7.2.2 Block diagram



The block diagram of the Servo Amplifier servo control section is shown above. (The current loop is omitted.)

(1) Actual loop section

A control loop designed to control the actual motor and acts to control the servo system stably in response to the load torque of the machine.

(2) Model section

Acts to provide the ideal operation values to the current loop in response to the command.

(3) Auto tuning section

Judges the load inertia moment of the machine fitted with the actual motor from the operation error of the motor to change each control gain in real time.

The gains changed by auto tuning are PG1, VG1, PG2, VG2 and VIC.

7.2.3 What is auto tuning?

The load inertia moment is estimated from the angular speed (ω) and torque (T) in accordance with the equation of motion (7.1) used for motor acceleration/deceleration. In actuality, the acceleration/deceleration characteristics of the model and those of the actual motor are compared to estimate the inertia moment of the load in real time.

$$J\frac{d\omega}{dt} = T \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (7.1)$$

J : Inertia moment
ω : Angular speed
T : Torque

Real-time auto tuning is performed in the following procedure:

(1) When the motor makes acceleration/deceleration, load inertia moment JL is estimated in the above method to calculate the load inertia moment ratio (GD2).
(2) Each gain (PG1, VG1, PG2, VG2, VIC) to the calculated load inertia moment ratio (GD2) is changed according to the response level set in parameter No. 2. Note that these gains have been patterned beforehand to satisfy the aforementioned stabilization condition.

7.3 Gain Adjustment by Auto Tuning

7.3.1 Adjustment method

In the factory setting of the servo amplifier, auto tuning is valid and the response setting is "2".
The initial settings provide sufficient tuning for general machines. Higher-level tuning can be provided by adjusting the response setting (parameter No. 2) according to machine rigidity.
The following table lists guidelines for response setting to drive systems. Choose slow response when using a reduction gear having backlash:

Main Drive System		Fast Response	Middle Response	Slow Response
Ballscrew	Direct coupling	←	→	
	With reduction gear	←	→	
Rack & pinion	Direct coupling		←	→
	With reduction gear		←	→
Timing belt	Direct coupling		←	→
	With reduction gear		←	→
Chain	Direct coupling		←	→
	With reduction gear		←	→

The following is how to adjust the response setting to machine phenomena:

Actual Machine Operation	Ideal Machine Operation	Parameter No. 2 Setting
Settling time is long	Reduce settling time.	Increase response setting.
Large overshoot at stop	Reduce overshoot.	Decrease response setting. Set machine selection setting to "large friction".
Gear sound generated from machine	Reduce gear sound.	Decrease response setting.

Note: Settling time indicates time from zero command pulse to servo motor stop.

7.3.2 Valid conditions

POINT

- If the acceleration/deceleration time is long or the motor speed used is only low speed, the valid conditions of auto tuning are not satisfied. Therefore, it may result in false tuning.
  In this case, after performing operation which satisfies the auto tuning conditions, set parameter No. 20 to "auto tuning not executed".

This section provides constraints on the operation pattern to enable excellent auto tuning. If the conditions in this section cannot be satisfied, normal auto tuning may not be performed. In this case, after executing auto tuning in operation which satisfies the conditions given in this section, make auto tuning invalid to disallow the gain setting from being changed.

(1) Set the acceleration time (time until the preset speed is reached) to 5s or less and the acceleration/deceleration current to 50% or more.
(2) Perform operation several times until the cumulative acceleration/deceleration time is 1s or more.
(3) Set the servo motor speed to 500r/min or more.

7.4 Manual Gain Adjustment

On some machines, gain adjustment may not be made by auto tuning or excellent gain setting may not be made if gain adjustment is performed by auto tuning. In this case, adjust the gains manually. Use any of the methods given in this section to adjust the gains.

7.4.1 When machine rigidity is low

(1) Machine condition

Because of low machine rigidity, the response setting of auto tuning is set to slow response and it takes too much time to reach the target position.

When the machine or motor shaft is moved lightly at a stop, it moves easily.

(2) Adjustment procedure

(a) Adjustment 1

1) Execute auto tuning with the response setting of the level at which machine will not vibrate. Set 0101 in parameter No. 2.
2) Set "Not executed" auto tuning in parameter No. 2.
3) Gradually decrease the speed integral compensation VIC (parameter No. 38) setting.

(b) Adjustment 2

1) Perform auto tuning with the response setting of slow response. Set 0101 in parameter No. 2.
2) Set the machine resonance suppression filter (Parameter No. 22) in order from higher to lower frequencies.
3) Alternate a start and a stop several times, execute auto tuning, and check whether the machine does not vibrate.
4) If the machine condition does not become excellent after the above adjustment, reduce the setting of speed integral compensation as in Adjustment 1.

7.4.2 When the machine vibrates due to machine resonance frequency

(1) Machine condition

The servo motor shaft is oscillating at high frequency (100Hz or more).

The servo motor shaft motion cannot be confirmed visually. However, if the machine generates large noise and vibrates, make Adjustment 1.

If higher "response setting" of auto tuning increases vibration, make Adjustment 2.

(2) Adjustment procedure

(a) Adjustment 1

1) Perform auto tuning with the response setting of slow response.
   Set 0101 in parameter No. 2.
2) Set 563Hz or 375Hz to the machine resonance suppression filter (Parameter No. 22).
3) Alternate a start and a stop several times, execute auto tuning, and check whether the machine does not vibrate.
4) Decrease the machine resonance suppression filter value gradually and repeat step 3).
   The optimum value is provided at the point where vibration is minimum.
5) To further shorten the settling time, gradually increase the response setting in parameter No. 2 and repeat steps 1) to 4).

(b) Adjustment 2

1) Choose the response setting of slow response.
   Set 0101 in parameter No. 2.
2) Set the load inertia moment ratio (machine inertia moment ratio in parameter No. 34).
   If an exact machine inertia moment ratio is unknown, enter an approximate value.
   When the value is set in this parameter, the following parameters are set automatically. When there is no machine resonance, the value of each parameter is set to the ideal gain for the parameter No. 34 value.

Parameter No.	Symbol	Name
No. 6	PG1	Position loop gain 1
No. 35	PG2	Position loop gain 2
No. 36	VG1	Speed loop gain 1
No. 37	VG2	Speed loop gain 2
No. 38	VIC	Speed integral compensation

3) Set parameter No. 2 to □□□2 (auto tuning not executed).
4) Decrease the speed loop gain 2 (parameter No. 37) to a value about 100 to 200 smaller than the automatically set value.
   The optimum value is provided at the point just before vibration increases.
5) Set 563Hz or 375Hz to the machine resonance suppression filter (Parameter No. 22).
6) Alternate a start and a stop several times, execute auto tuning, and check whether the machine does not vibrate.
7) Decrease the machine resonance suppression filter value gradually and repeat step 6).
   The optimum value is provided at the point where vibration is minimum.
8) When there is no machine resonance, check the operating status and gradually increase the speed loop gain 2 (parameter No. 37) and repeat steps 5) to 7).
   Set the value about 50 to 100 smaller than the value at which gear sound begins to be generated.
   Make this gain a little if there is variation in the machine because a timing belt or the like is used.
9) To further shorten the settling time, gradually increase the response setting of parameter No. 2 and repeat steps 1) to 8).

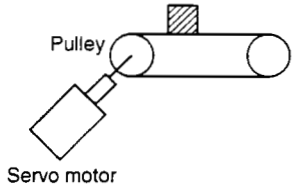
7.4.3 Load inertia moment is 20 or more times

(1) Machine condition

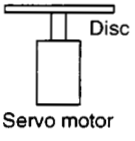
The machine inertia moment is 20 times or more and the servo motor oscillates at low frequency (5Hz or more). At this time, servo motor shaft vibration can be confirmed visually.

This adjustment method is valid for the following machines:

(a) Machine in which a timing belt is driven without reduction gear



(b) Machine in which a disc is rotated without reduction gear



(c) Machine of which ballscrew lead is long

(2) Adjustment procedure

1) Choose the response setting of slow response.
   Set 0101 in parameter No. 2.
2) Set the load inertia moment ratio (machine inertia moment ratio in parameter No.34).
   If an exact machine inertia moment ratio is unknown, enter an approximate value.
   When the value is set in this parameter, the following parameters are set automatically. When there is no machine resonance, the value of each parameter is set to the ideal gain for the parameter No.34 value.

Parameter No.	Symbol	Name
No. 6	PG1	Position loop gain 1
No. 35	PG2	Position loop gain 2
No. 36	VG1	Speed loop gain 1
No. 37	VG2	Speed loop gain 2
No. 38	VIC	Speed integral compensation

3) Set parameter No. 2 to □2□□ (auto tuning not executed).
4) Alternate a start and a stop several times and check whether the machine does not vibrate.
5) If vibration still persists, repeat steps 1) to 4).
6) If vibration still persists, make (a) adjustment 1 and (b) adjustment 2 in paragraph (2) of Section 7.4.2.
7) If you want to further increase the response, set parameter No. 2 to "auto tuning executed" (third digit) with operation at a stop, and increase the response setting (first digit). After that, set the parameter to "auto tuning not executed" (third digit).
   For example, after setting parameter No. 2 to "01□2", set it to "02□2".
8) Reducing the speed loop's integral time constant (parameter No. 38) may improve the performance. However, making it too small may generate vibration.

7.4.4 When shortening the settling time

(1) Machine condition

The settling time will be increased by the gains provided by auto tuning.

(2) Adjustment procedure

1) Choose the response setting of slow response.
   Set 0101 in parameter No.2.
2) Alternate a start and a stop several times, execute auto tuning, and check whether the machine does not vibrate.
3) Set the load inertia moment ratio (machine inertia moment ratio in parameter No. 34).
   If an exact machine inertia moment ratio is unknown, enter an approximate value.
   When the value is set in this parameter, the following parameters are set automatically. When there is no machine resonance, the value of each parameter is set to the ideal gain for the parameter No. 34 value.

Parameter No.	Symbol	Name
No. 6	PG1	Position loop gain 1
No. 35	PG2	Position loop gain 2
No. 36	VG1	Speed loop gain 1
No. 37	VG2	Speed loop gain 2
No. 38	VIC	Speed integral compensation

4) Set □2□□ in parameter No. 2 to make auto tuning invalid.
   Make the parameter No. 6, 35 to 38 settings manually adjustable.
5) Check the operating status and adjust the following parameter values:

Parameter No.	Symbol	Name	Description
No. 6	PG1	Position loop gain 1	Higher setting shortens the settling time but is liable to cause overshooting.
No. 35	PG2	Position loop gain 2	
No. 36	VG1	Speed loop gain 1	Higher setting improves the servo response level but is liable to cause vibration.
No. 37	VG2	Speed loop gain 2	
No. 38	VIC	Speed integral compensation	Lower setting keeps the speed constant to load disturbance and increases holding force at a stop (servo rigidity) but is liable to cause overshooting.

Make adjustment by gradually increasing the parameter No. 6, 35 to 37 settings at the same ratio and reducing the speed integral compensation (parameter No. 38). The optimum value is provided at the point just before vibration increases. Use of the machine resonance suppression filter (parameter No. 22) may increase the limit point. However, note that the setting increased up to the limit point may cause resonance due to the machine's variations and changes with time.

7.4.5 When the same gain is used for two or more axes

(1) Machine condition

To perform interpolation operation with two or more axes of servo amplifiers, the position loop gains of the axes are set to the same value.

(2) Adjustment procedure

1) To adjust the gains of each axis, adjust the gains of all axes in the adjustment procedures in Sections 7.4.1 to 7.4.4.
2) Set □0□□ or □2□□ in parameter No. 2.

□0□□: Interpolation control ····· The following parameter values change at the next start/stop.

Parameter No.	Symbol	Name
No. 35	PG2	Position loop gain 2
No. 37	VG2	Speed loop gain 2
No. 38	VIC	Speed integral compensation

□2□□: No auto tuning ····· Make auto tuning invalid and set each gain manually.

3) Match position loop gain 1 to the minimum value of each axis to make the gains of all axes equal.

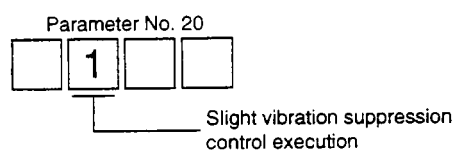
7.5 Slight Vibration Suppression Control

The slight vibration suppression control mode is used to reduce servo-specific ±1 pulse vibration at the time of a stop. This mode produces an effect especially when the ratio of load inertia moment to servo motor inertia moment is small (2 to 5 times). Note that when vibration is attributable to looseness (such as gear backlash) or machine resonance, use the machine resonance suppression filter in parameter No.22. The slight vibration suppression control mode should be used after real-time auto tuning or manual gain adjustment.

Usage

First, perform real-time auto tuning or manual gain adjustment so that vibration falls within ±2 to 3 pulses.

Set □1□□ in parameter No. 20 to enter the slight vibration suppression mode at the time of a stop.



8. INSPECTION

⚠ WARNING	• Before starting maintenance/inspection, switch power off, and after more than 10 seconds have elapsed, confirm that the voltage is safe in the tester or the like. Otherwise, you may get an electric shock. • Any person who is involved in inspection should be fully competent to do the work. Otherwise, you may get an electric shock. For repair and parts replacement, contact your safes representative.

POINT

- Do not test the servo amplifier with a megger (measure insulation resistance), or it may become faulty.
- Do not disassemble and/or repair the equipment on customer side.

(1) Inspection

Check the cables and the like for scratches and cracks. Perform periodic inspection according to operating conditions.

(2) Life

The following parts must be changed periodically as listed below. If any part is found faulty, it must be changed immediately even when it has not yet reached the end of its life, which depends on the operating method and environmental conditions.

Part Name	Life Guideline
Smoothing capacitor	10 years
Relay	100,000 times

(a) Smoothing capacitor : Affected by ripple currents, etc. and deteriorates in characteristic. The life of the capacitor greatly depends on ambient temperature and operating conditions. The capacitor will reach the end of its life in 10 years of continuous operation in normal air-conditioned environment.

(b) Relays : Their contacts will wear due to switching currents and contact faults occur. Relays reach the end of their life at cumulative 100,000 switching times (switching life), which depends on the power supply capacity.

9. TROUBLESHOOTING

9.1 Trouble at Start-Up

> ⚠ CAUTION • Excessive adjustment or change of parameter setting must not be made as it will make operation instable.

> POINT
> • Using the optional Servo Configuration software, you can refer to unrotated servo motor reasons, etc.

The following faults may occur at start-up. If any of such faults occurs, take the corresponding action.

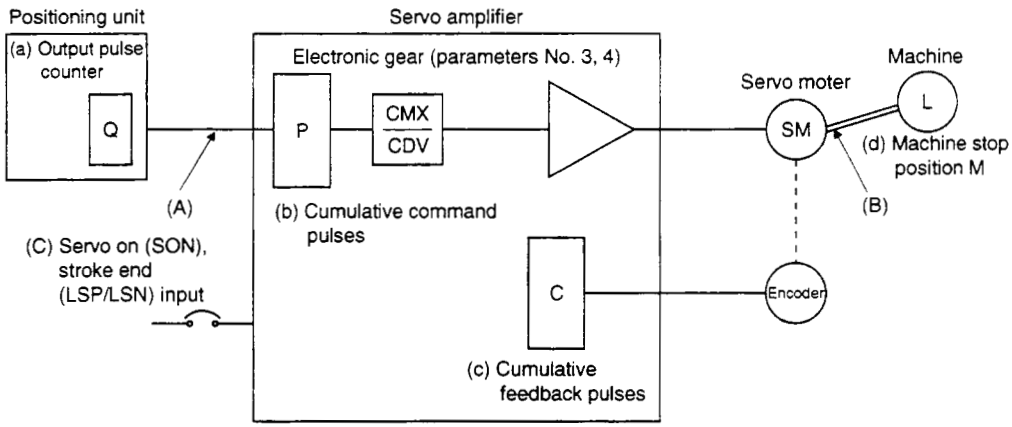
9.1.1 Position control mode

(1) Troubleshooting

No.	Start-Up Sequence	Fault	Investigation	Possible Cause	Refer To
1	Power on	· LED is not lit. · LED flickers.	Not improved if connectors CN1A, CN1B and CNP2 are disconnected.	1. Power supply voltage fault 2. Servo amplifier is faulty. 3. CNP1 connection fault	
			Improved when connectors CN1A and CN1B are disconnected.	Power supply of CNP1 cabling is shorted.	
			Improved when connector CNP2 is disconnected.	1. Power supply of encoder cabling is shorted. 2. Encoder is faulty.	
		Alarm occurs.	Refer to Section 9.2 and remove cause.		Section 9.2
2	Switch on servo-on signal.	Alarm occurs.	Refer to Section 9.2 and remove cause.		Section 9.2
		Servo motor shaft is not servo-locked (is free).	Check the display to see if the servo amplifier is ready to operate.	1. Servo on signal is not input. (Wiring mistake) 2. 24VDC power is not supplied to COM.	Section 6.3
3	Enter input command. (Test operation)	Servo motor does not rotate.	Check cumulative command pulses.	1. Wiring mistake (a) For open collector pulse train input, 24VDC power is not supplied to OPC. (b) LSP/LSN-SG are not connected. 2. No pulses is input.	Section 6.2

No.	Start-Up Sequence	Fault	Investigation	Possible Cause	Refer To
4	Gain adjustment	Rotation ripples (speed fluctuations) are large at low speed.	Make gain adjustment in the following procedure: 1. Increase the auto tuning response level. 2. Repeat acceleration and deceleration several times to complete auto tuning.	Gain adjustment fault	Chapter 7
		Large load inertia moment causes the servo motor shaft to oscillate side to side.	Make gain adjustment in the following procedure: If the servo motor may be run with safety, repeat acceleration and deceleration several times to complete auto tuning.	Gain adjustment fault	Chapter 7
5	Cyclic operation	Position shift occurs	Confirm the cumulative command pulses, cumulative feedback pulses and actual servo motor position.	Pulse counting error, etc. due to noise.	(2) in this section

(2) How to find the cause of position shift



When a position shift occurs, check (a) output pulse counter, (b) cumulative command pulse display, (c) cumulative feedback pulse display, and (d) machine stop position in the above diagram.
(A), (B) and (C) indicate position shift causes. For example, (A) indicates that noise entered the wiring between positioning unit and servo amplifier, causing pulses to be mis-counted.

In a normal status without position shift, there are the following relationships:

1) Q = P (positioning unit's output counter = servo amplifier's cumulative command pulses)

2) $P \cdot \frac{\text{CMX (parameter No. 3)}}{\text{CDV (parameter No. 4)}}$

= C (cumulative command pulses × electronic gear = cumulative feedback pulses)

3) $C \cdot \Delta\ell = M$ (cumulative feedback pulses × travel per pulse = machine position)

Check for a position shift in the following sequence:

1) When $Q \neq P$

Noise entered the pulse train signal wiring between positioning unit and servo amplifier, causing pulses to be miss-counted. (Cause A)

Make the following check or take the following measures:

- Check how the shielding is done.
- Change the open collector system to the differential line driver system.
- Run wiring away from the power circuit.
- Install a data line filter. (Refer to Section 12.2.4.)

2) When $P \cdot \frac{CMX}{CDV} \neq C$

During operation, the servo on signal (SON) or forward/reverse rotation stroke end signal was switched off or the clear signal (CR) and the reset signal (RES) switched on. (Cause C)

If a malfunction may occur due to much noise, increase the input filter setting (parameter No. 1).

3) When $C \cdot \Delta\ell \neq M$

Mechanical slip occurred between the servo motor and machine. (Cause B)

9.1.2 Speed control mode

No.	Start-Up Sequence	Fault	Investigation	Possible Cause	Refer To
1	Power on	· LED is not lit. · LED flickers.	Not improved if connectors CN1A, CN1B and CNP2 are disconnected.	1. Power supply voltage fault 2. Servo amplifier is faulty.	
			Improved when connectors CN1A and CN1B are disconnected.	Power supply of CN1 cabling is shorted.	
			Improved when connector CNP2 is disconnected.	1. Power supply of encoder cabling is shorted. 2. Encoder is faulty.	
		Alarm occurs.	Refer to Section 9.2 and remove cause.		Section 9.2
2	Switch on servo-on signal.	Alarm occurs.	Refer to Section 9.2 and remove cause.		Section 9.2
		Servo motor shaft is not servo-locked (is free).	Check the display to see if the servo amplifier is ready to operate.	1. Servo on signal is not input. (Wiring mistake) 2. 24VDC power is not supplied to COM.	Section 6.3
3	Switch on forward rotation start (ST1) or reverse rotation start (ST2).	Servo motor does not rotate.	Call the status display and check the input voltage of the analog speed command.	Analog speed command is 0V.	Section 6.2
			Call the external I/O signal display and check the ON/OFF status of the input signal.	LSP, LSN, ST1 or ST2 is off.	Section 6.6
			Check the internal speed commands 1 to 3 (parameters No. 8 to 10).	Set value is 0.	(1), Section 5.1.2
			Check the internal torque limit 1 (parameter No. 28).	Set value is 0.	
4	Gain adjustment	Rotation ripples (speed fluctuations) are large at low speed.	Make gain adjustment in the following procedure: 1. Increase the auto tuning response level. 2. Repeat acceleration and deceleration several times to complete auto tuning.	Gain adjustment fault	Chapter 7
		Large load inertia moment causes the servo motor shaft to oscillate side to side.	Make gain adjustment in the following procedure: If the servo motor may be run with safety, repeat acceleration and deceleration several times to complete auto tuning.	Gain adjustment fault	Chapter 7

9.1.3 Torque control mode

No.	Start-Up Sequence	Fault	Investigation	Possible Cause	Refer To
1	Power on	· LED is not lit. · LED flickers.	Not improved if connectors CN1A, CN1B and CNP2 are disconnected.	1. Power supply voltage fault 2. Servo amplifier is faulty.	
			Improved when connectors CN1A and CN1B are disconnected.	Power supply of CN1 cabling is shorted.	
			Improved when connector CNP2 is disconnected.	1. Power supply of encoder cabling is shorted. 2. Encoder is faulty.	
		Alarm occurs.	Refer to Section 9.2 and remove cause.		Section 9.2
2	Switch on servo-on signal.	Alarm occurs.	Refer to Section 9.2 and remove cause.		Section 9.2
		Servo motor shaft is not servo-locked (is free).	Check the display to see if the servo amplifier is ready to operate.	1. Servo on signal is not input. (Wiring mistake) 2. 24VDC power is not supplied to COM.	Section 6.3
3	Switch on forward rotation start (RS1) or reverse rotation start (RS2).	Servo motor does not rotate.	Call the status display and check the analog torque command.	Analog torque command is 0V.	Section 6.2
			Call the external I/O signal display and check the ON/OFF status of the input signal.	RS1 or RS2 is off.	Section 6.6
			Check the internal speed limits 1 to 3 (parameters No. 8 to 10).	Set value is 0.	(1), Section 5.1.2
			Check the internal torque limit 1 (parameter No. 28).	Set value is 0.	

9.2 When Alarm or Warning Has Occurred

9.2.1 Alarms and Warning list

When a fault occurs during operation, the corresponding alarm or warning is displayed. If any alarm or warning has occurred, refer to Section 9.2.2 or 9.2.3 and take the appropriate action.
Set □□□1 in parameter No. 49 to output the alarm code in ON/OFF status across the corresponding pin and SG. Warnings (A. 96 to A. E9) have no codes. Any alarm code is output at occurrence of the corresponding alarm. In the normal status, the signals available before alarm code setting (CN1B-19: ZSP, CN1A-18: INP or SA, CN1A-19: RD) are output.

	Display	(Note 2) Alarm Code			Name	Alarm Deactivation		
		CN1B-19 pin	CN1A-18 pin	CN1A-19 pin		Power OFF→ON	Press "SET" on current alarm screen.	Alarm reset (RES) signal
Alarms	A. 10	0	1	0	Undervoltage	○	○	○
	A. 11	0	0	0	Board error 1	○		
	A. 12	0	0	0	Memory error 1	○		
	A. 13	0	0	0	Clock error	○		
	A. 15	0	0	0	Memory error 2	○		
	A. 16	1	1	0	Encoder error 1	○		
	A. 17	0	0	0	Board error 2	○		
	A. 18	0	0	0	Board error 3	○		
	A. 20	1	1	0	Encoder error 2	○		
	A. 24	1	0	0	Motor output ground fault	○		
	A. 31	1	0	1	Overspeed	○	○	○
	A. 32	1	0	0	Overcurrent	○	○	○
	A. 33	0	0	1	Overvoltage	○		
	A. 35	1	0	1	Command pulse frequency error	○	○	○
	A. 37	0	0	0	Parameter error	○		
	A. 50	0	1	1	Overload 1	○ (Note 1)	○ (Note 1)	○ (Note 1)
	A. 51	0	1	1	Overload 2	○ (Note 1)	○ (Note 1)	○ (Note 1)
	A. 52	1	0	1	Error excessive	○	○	○
	A. 8E	0	0	0	Seal communication error	○	○	○
	8888	0	0	0	Watchdog	○		
Warnings	A. E1				Overload warning	Removing the cause of occurrence deactivates the alarm automatically.		
	A. E6				Servo forced stop			
	A. E9				Main circuit off warning			

Note 1.: Deactivate the alarm about 15 minutes of cooling time after removing the cause of occurrence.
2. 0: OFF, 1: ON

9.2.2 Remedies for alarms

> **⚠ CAUTION** • When any alarm has occurred, eliminate its cause, ensure safety, then reset the alarm, and restart operation. Otherwise, injury may occur.

POINT

- When any of the following alarms has occurred, always remove its cause and allow about 15 minutes for cooling before resuming operation. If operation is resumed by switching control circuit power off, then on to reset the alarm, the servo amplifier and servo motor may become faulty.
  - Overload 1 (A. 50)
  - Overload 2 (A. 51)
- The alarm can be deactivated by switching power off, then on or by turning on the reset signal (RES). For details, refer to Section 9.2.1.

When an alarm occurs, the trouble signal (ALM) switches off and the dynamic brake is operated to stop the servomotor. At this time, the display indicates the alarm No.
The servo motor comes to a stop. Remove the cause of the alarm in accordance with this section. The optional Servo Configuration Software may be used to refer to the cause.

Display	Name	Definition	Cause	Action
A. 10	Undervoltage	Power supply voltage dropped to 20V or less	1. Power supply voltage is low.	Review the power supply.
			2. Power failed instantaneously for 15ms or longer.	
			3. Shortage of power supply capacity caused the power supply voltage to drop at start, etc.	
			4. Power switched on within 5s after it had switched off.	
			5. Faulty parts in the servo amplifier Checking method Alarm (10) occurs if power is switched on after connectors CN1A, CN1B, CNP2, CNP3 are disconnected.	Change the servo amplifier.
A. 11	Board error 1	Printed board faulty	Faulty parts in the servo amplifier Checking method Alarm (any of 11 to 13 and 15) occurs if power is switched on after connectors CN1A, CN1B, CNP2, CNP3 are disconnected.	Change the servo amplifier.
A. 12	Memory error 1	RAM, ROM memory fault		
A. 13	Clock error	Printed board fault		
A. 15	Memory error 2	EEPROM fault		
A. 16	Encoder error 1	Communication error occurred between encoder and servo amplifier.	1. CNP2 connector disconnected.	Connect correctly.
			2. Encoder fault	Change the servo motor.
			3. Motor cable faulty (Encoder wiring broken or shorted)	Repair or change cable.

Display	Name	Definition	Cause	Action
A. 17	Board error 2	CPU/parts fault	Faulty parts in the servo amplifier Checking method Alarm (A. 17 or A. 18) occurs if power is switched on after connectors CN1A, CN1B, CNP2, CNP3 are disconnected.	Change the servo amplifier.
A. 18	Board error 3	Printed board fault		
A. 20	Encoder error 2	Communication error occurred between encoder and servo amplifier.	Motor cable faulty (Encoder wiring broken or shorted)	Repair or change the cable.
A. 24	Motor outout ground fault	Ground fault occurred at the servo motor outputs (U,V and W phases) of the servo amplifier.	Servo motor power cable insulation deteriorated.	Change the cable.
A. 31	Overspeed	Speed has exceeded the instantaneous permissible speed.	1. Input command pulse frequency exceeded the permissible instantaneous speed frequency.	Set command pulses correctly.
			2. Small acceleration/deceleration time constant caused overshoot to be large.	Increase acceleration/deceleration time constant.
			3. Servo system is instable to cause overshoot.	1. Re-set servo gain to proper value. 2. If servo gain cannot be set to proper value: 1) Reduce load inertia moment ratio; or 2) Reexamine acceleration/deceleration time constant.
			4. Electronic gear ratio is large (parameters No. 3, 4)	Set correctly.
			5. Encoder faulty.	Change the servo motor.
A. 32	Overcurrent	Current that flew is higher than the permissible current of the servo amplifier.	1. Short occurred in servo amplifier output phases U, V and W.	Correct the wiring.
			2. Transistor (IPM) of the servo amplifier faulty. Checking method Alarm (A. 32) occurs if power is switched on after U, V and W are disconnected.	Change the servo amplifier.
			3. Ground fault occurred in servo amplifier output phases U, V and W.	Correct the wiring.
			4. External noise caused the overcurrent detection circuit to misoperate.	Take noise suppression measures.
A. 33	Overvoltage	Input value of converter bus voltage reached or exceeded 35V.	Power supply voltage is outside the permissible voltage range.	Change battery.

Display	Name	Definition	Cause	Action
A. 35	Command pulse frequency error	Input pulse frequency of the command pulse is too high.	1. Pulse frequency of the command pulse is too high.	Change the command pulse frequency to a proper value.
			2. Noise entered command pulses.	Take action against noise.
			3. Command device failure	Change the command device.
A. 37	Parameter error	Parameter setting is wrong.	Servo amplifier fault caused the parameter setting to be rewritten.	Change the servo amplifier.
A. 50	Overload 1	Load exceeded overload protection characteristic of servo amplifier. Load ratio 200%: 85s or more	1. Servo amplifier is used in excess of its continuous output current.	1. Reduce load. 2. Review operation pattern. 3. Use servo motor that provides larger output.
			2. Servo system is instable and hunting.	1. Repeat acceleration/ deceleration to execute auto tuning. 2. Change auto tuning response setting. 3. Set auto tuning to OFF and make gain adjustment manually.
			3. Machine struck something.	1. Review operation pattern. 2. Install limit switches.
			4. Wrong connection of servo motor. Servo amplifier's output terminals U, V, W do not match servo motor's input terminals U, V, W.	Connect correctly.
			5. Encoder faulty. Checking method When the servo motor shaft is rotated slowly with the servo off, the cumulative feedback pulses should vary in proportion to the rotary angle. If the indication skips or returns midway, the encoder is faulty.	Change the servo motor.

Display	Name	Definition	Cause	Action
A. 51	Overload 2	Machine collision or the like caused max. output current to flow successively for several seconds. Servo motor locked: 1s or more	1. Machine struck something.	1. Review operation pattern. 2. Install limit switches.
			2. Wrong connection of servo motor. Servo amplifier's output terminals U, V, W do not match servo motor's input terminals U, V, W.	Connect correctly.
			3. Servo system is instable and hunting.	1. Repeat acceleration/ deceleration to execute auto tuning. 2. Change auto tuning response setting. 3. Set auto tuning to OFF and make gain adjustment manually.
			4. Encoder faulty. Checking method When the servo motor shaft is rotated slowly with the servo off, the cumulative feedback pulses should vary in proportion to the rotary angle. If the indication skips or returns midway, the encoder is faulty.	Change the servo motor.
A. 52	Error excessive	Droop pulse value of the deviation counter exceeded 80k pulses.	1. Acceleration/deceleration time constant is too small.	Increase the acceleration/deceleration time constant.
			2. Torque limit value (parameter No.28) is too small.	Increase the torque limit value.
			3. Motor cannot be started due to torque shortage caused by power supply voltage drop.	1. Review the power supply capacity. 2. Use servo motor which provides larger output.
			4. Position control gain 1 (parameter No.6) value is small.	Increase set value and adjust to ensure proper operation.
			5. Servo motor shaft was rotated by external force.	1. When torque is limited, increase the limit value. 2. Reduce load. 3. Use servo motor that provides larger output.
			6. Machine struck something.	1. Review operation pattern. 2. Install limit switches.
			7. Encoder faulty	Change the servo motor.
			8. Wrong connection of servo motor. Servo amplifier's output terminals U, V, W do not match servo motor's input terminals U, V, W.	Connect correctly.

Display	Name	Definition	Cause	Action
A. 8E	Serial communication error	Serial communication error occurred between servo amplifier and communication device (e.g. personal computer).	1. Communication cable fault (Open cable or short circuit)	Repair or change the cable.
			2. Communication device (e.g. personal computer) faulty	Change the communication device (e.g. personal computer).
8888	Watchdog	CPU, parts faulty	Fault of parts in servo amplifier Checking method Alarm (8888) occurs if power is switched on after connectors CN1A, CN1B, CNP2, CNP3 are disconnected.	Change servo amplifier.

9.2.3 Remedies for Warnings

If A.E1 (overload warning) occurs, operation may be continued but an alarm may take place or proper operation may not be performed. If another warning (A.E6 or A.E9) occurs, the servo amplifier will go into a servo-off status. Eliminate the cause of the warning according to this section. Use the optional Servo Configuration software to refer to the cause of warning.

Display	Name	Definition	Cause	Action
A. E1	Overload warning	There is a possibility that overload alarm 1 or 2 may occur.	Load increased to 85% or more of overload alarm 1 or 2 occurrence level. Cause, checking method Refer to A. 50, 51.	Refer to A. 50, A. 51.
A. E6	Servo forced stop	EMG-SG are open.	External forced stop was made valid. (EMG-SG opened.)	Ensure safety and deactivate forced stop.
A. E9	Main circuit off warning	Servo was switched on with main circuit power off.		Switch on main circuit power.

10. SPECIFICATIONS

10.1 Servo Amplifier Standard Specifications

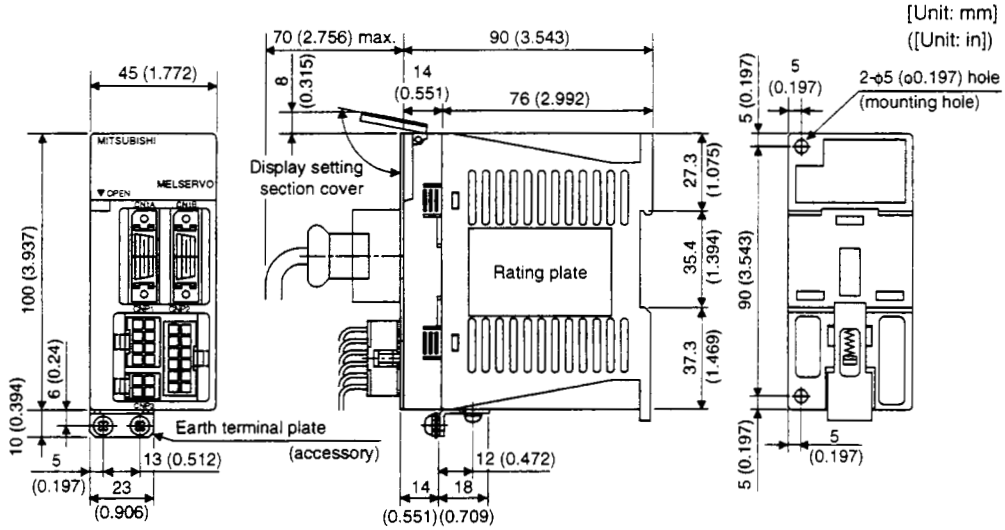
Item \ Servo Amplifier			MR-J2-03A5
Circuit power supply	Voltage		21.6 to 30VDC (instantaneous permissible voltage 34V)
	Power supply capacity	HC-AQ0135D	Continuous 0.8A, max. 2.4A
		HC-AQ0235D	Continuous 1.6A, max. 4.8A
		HC-AQ0335D	Continuous 2.4A, max. 7.2A
Control circuit power supply (Note)			24VDC±10%, 200mA (400mA when using the servo motor equipped with electromagnetic brake)
System			Sine-wave PWM control, current control system
Dynamic brake			Built-in
Protective functions			Overcurrent shut-off, regenerative overvoltage shut-off, overload shut-off (electronic thermal relay), servo motor overheat protection, encoder fault protection, undervoltage, instantaneous power failure protection, overspeed protection, excessive error protection
Speed frequency response			250Hz or more
Position control mode	Max. input pulse frequency		500kpps (for differential receiver), 200kpps (for open collector)
	Command pulse multiplying factor		Electronic gear A/B, A, B: 1 to 32767, 1/50 < A/B < 50
	In-position range setting		0 to ±10000 pulse
	Error excessive		±80 kpulse
	Torque limit		Parameter setting system
Speed control mode	Speed control range		Analog speed command 1: 1000, internal speed command 1: 5000
	Analog speed command input		DC0 to ±10V
	Speed fluctuation ratio		–0.03% or less (load fluctuation 0 to 100%) ±0.02% or less (power fluctuation ±10%) ±3% or less
	Torque limit		Parameter setting system
Torque control mode	Analog torque command input		DC0 to ±8V (input impedance 10 to 12kΩ)
	Torque linearity		±10% or less
Structure			Open (IP00)
Environment	Ambient temperature		0 to +55 [°C] (non-freezing)
			32 to +131 [°F] (non-freezing)
	Ambient humidity		90%RH or less (non-condensing)
	storage temperature		–20 to +65 [°C] (non-freezing)
			–4 to +149 [°F] (non-freezing)
	storage humidity		90%RH or less (non-condensing)
	Ambient		Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt
	Altitude		Max. 1000m (3280ft) above sea level
	Vibration		5.9 [m/s^2] {0.6G} or less
			19.4 [ft/s^2] or less
Weight		[kg]	0.2
		[lb]	0.44

Note: To comply with the Low Voltage Directive, use a reinforced insulation type stabilizing power supply.

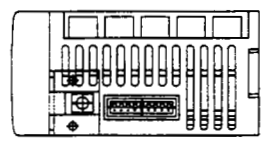
10.2 Outline Dimension Drawings

10.2.1 Servo amplifiers

[Unit: mm]
([Unit: in])



Servo Amplifier Model	Weight [kg] ([lb])
MR-J2-03A5	0.2 (0.44)



(Note)

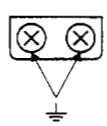
CNP1	
5	1
RDP	P24M
6	2
RDN	P24G
7	3
SDP	P24L
8	4
SDN	TRE

CNP2	
6	12
MR	MRR
5	11
P5	LG
4	10
SD	
3	9
B2	B1
2	8
U	W
1	7
E	V

CNP3	
3	1
SD	LG
4	2
TXD	RXD

Note: One connector (5557-08R) and 10 terminals (5556) for CNP1 wiring are included in the package.

Earth terminal



Terminal screw: M4
Tightening torque: 1.24 [N·m] (175.6 [oz·in])

10.2.2 Connectors

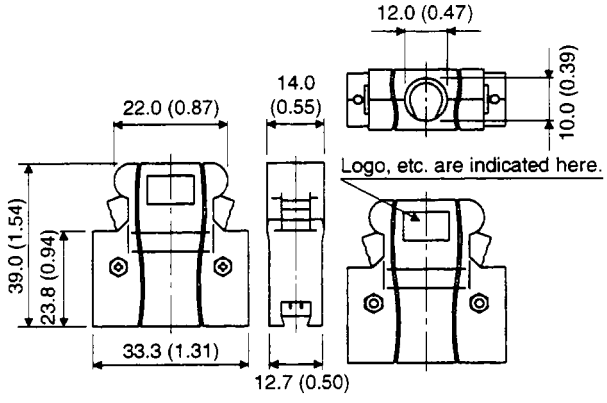
(1) Connectors for CN1A/CN1B

<Sumitomo 3M make>

Model [Unit: mm]

Connector : 10120-3000VE ([Unit: in])

Shell kit : 10320-52F0-008

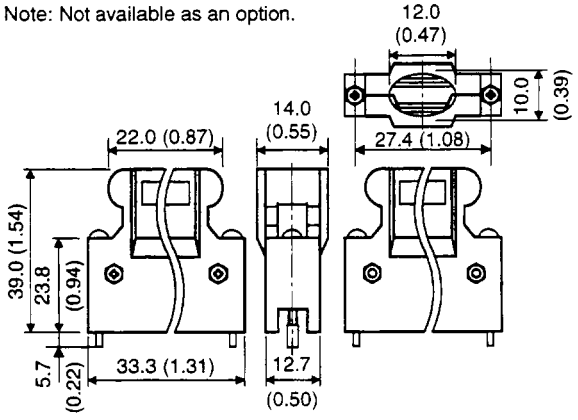


Model [Unit: mm]

Connector : 10120-3000VE ([Unit: in])

Shell kit : 10320-52A0-008

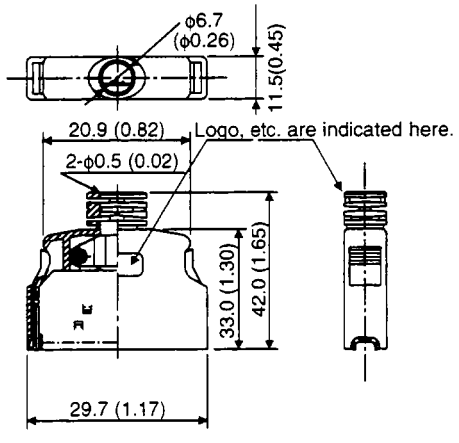
Note: Not available as an option.



Model [Unit: mm]

Connector : 10120-6000EL ([Unit: in])

Shell kit : 10320-3210-000



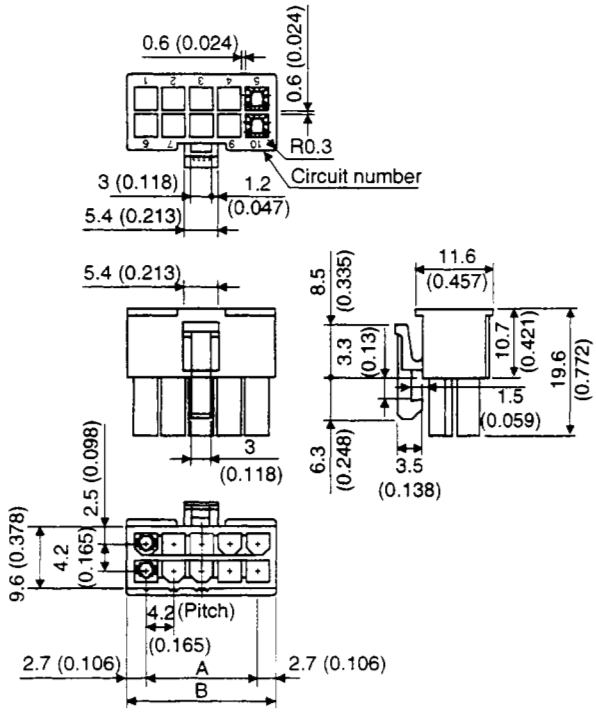
The crimping tool is required for wiring to the connector.
For the crimping tool, contact Nippon AMP.

(2) Connectors for CNP1/CNP2/CNP3

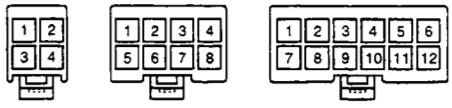
<molex make>

Connector

[Unit: mm]
([Unit: in])



Layout diagrams classified by the number of poles

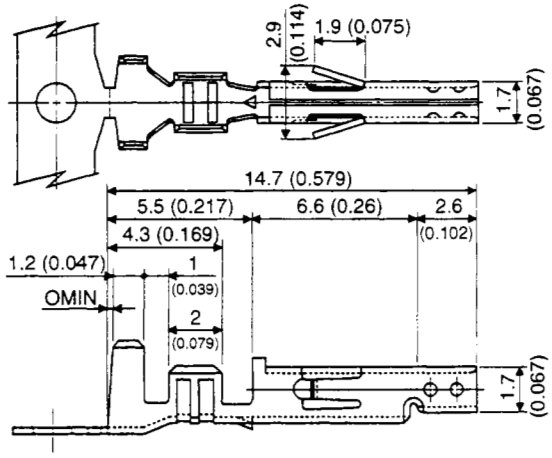


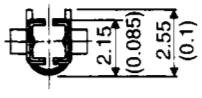
4 poles 8 poles 12 poles

Model	Variable Dimensions	
	A	B
5557-04R	4.2 (0.165)	9.6 (0.378)
5557-08R	12.6 (0.496)	18.0 (0.709)
5557-12R	21.0 (0.827)	26.4 (1.039)

Terminal
Model: 5556

[Unit: mm]
([Unit: in])





Applicable wire
- Core size : AWG#18 to #24 (5556-PBTL)
  AWG28 (5556-PBT2L)
- Sheath OD: φ3.1mm (φ0.122 in) max.
- Strip length: 3.0 to 3.5 [mm] (0.118 to 0.138 [in])

11. CHARACTERISTICS

11.1 Overload Protection Characteristics

An electronic thermal relay is built in the servo amplifier to protect the servo motor and servo amplifier from overloads. The operation characteristics of the electronic thermal relay are shown below. Overload 1 alarm (A. 50) occurs if overload operation performed is above the electronic thermal relay protection curve shown below. Overload 2 alarm (A. 51) occurs if the maximum current flew continuously for several seconds due to machine collision, etc. Use the equipment on the left-hand side area of the continuous or broken line in the graph.
If load is applied at stop (during servo lock), 70% of the rated torque must not be exceeded.

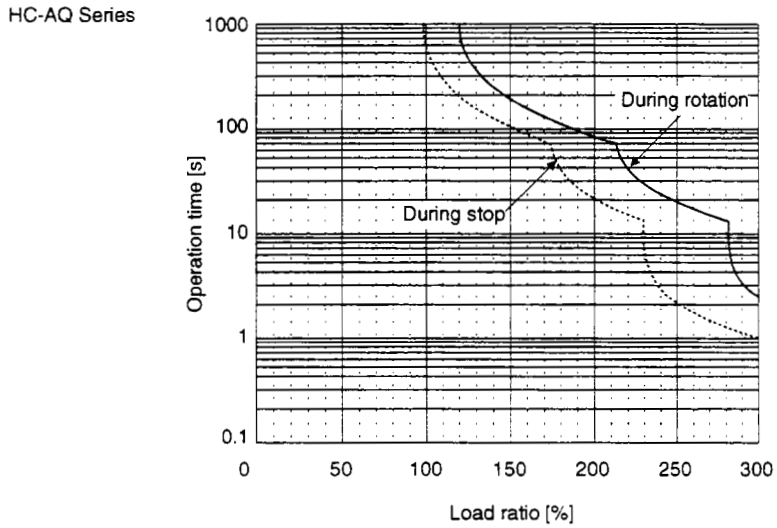


Fig 11.1 Electronic Thermal Relay Protection Characteristics

11.2 Dynamic Brake Characteristics

When an alarm, emergency stop or power failure occurs, the dynamic brake is operated to bring the servo motor to a sudden stop. Fig. 11.2 shows the pattern in which the servo motor comes to a stop when the dynamic brake is operated. Use Equation 11.1 to calculate an approximate coasting distance to a stop. The dynamic brake time constant τ varies with the servo motor and machine operation speeds. (Refer to Fig. 11.3.)

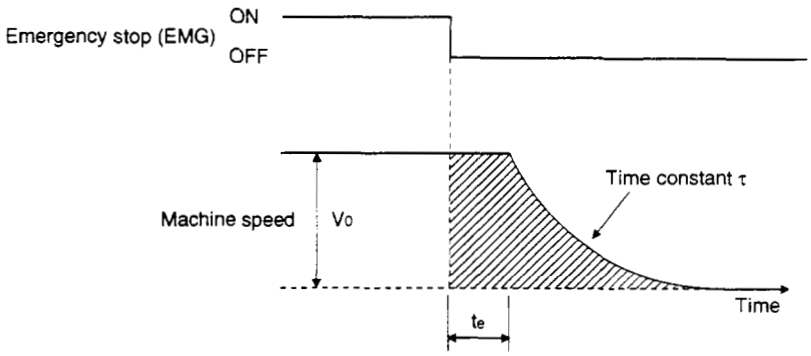


Fig. 11.2 Dynamic Brake Operation Diagram

$$Lmax = \frac{Vo}{60} \cdot \left\{ te + \tau \left[1 + \frac{JL}{JM} \right] \right\} \quad \cdots\cdots (11.1)$$

L max : Maximum coasting distance ····· [mm][in]
Vo : Machine rapid feedrate ····· [mm/min][in/min]
JM : Servo motor inertial moment ····· [kg · cm²][oz · in²]
JL : Load inertia moment converted into equivalent value on servo motor shaft ····· [kg · cm²][oz · in²]
τ : Brake time constant (Fig. 11.3) ····· [s]
te : Delay time of control section (Fig. 11.2) ····· [s]
(There is internal relay delay time of about 30ms.)

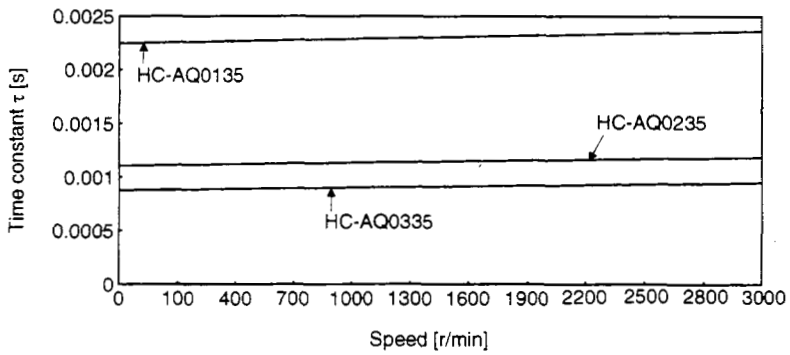


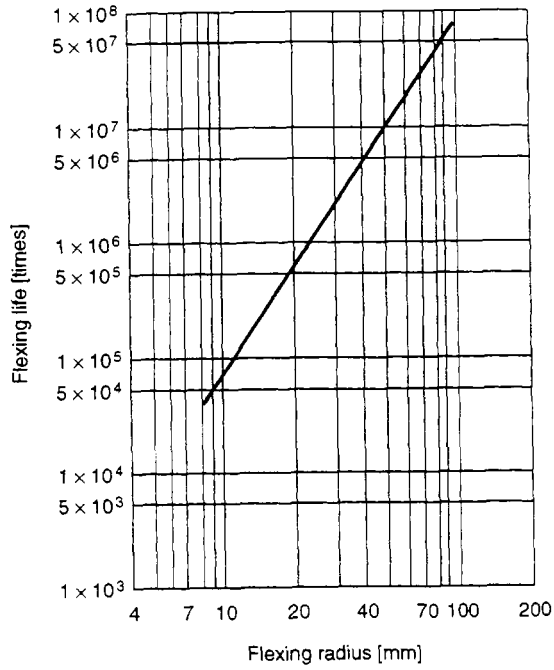
Fig. 11.3 Dynamic Brake Time Constant

Use the dynamic brake at the load inertia moment indicated in the following table. If the load inertia moment is higher than this value, the built-in dynamic brake may burn. If there is a possibility that the load inertia moment may exceed the value, contact Mitsubishi.

Servo Amplifier	Load Inertia Moment Ratio [times]
MR-J2-03A5	100

11.3 Encoder Cable Flexing Life

The flexing life of the MR-JRCBL□M-H cable is shown below. This graph gives calculated values. Since they are not guaranteed values, provide a little allowance for these values.



12. OPTIONS AND AUXILIARY EQUIPMENT

⚠ WARNING	• Before connecting any option or auxiliary equipment, switch power off, and after more than 10 seconds have elapsed, confirm that the voltage is safe in a tester or the like. Not doing so can cause an electric shock.

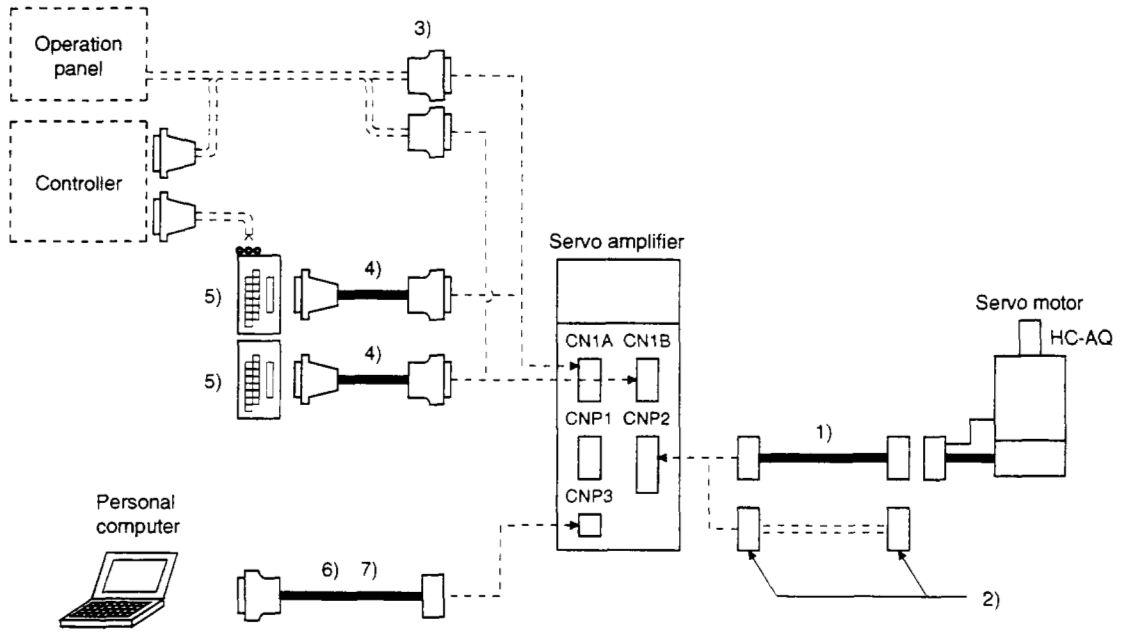
⚠ CAUTION	• Use the specified auxiliary equipment and options. Unspecified ones may lead to a fault or fire.

12.1 Options

12.1.1 Cables and connectors

(1) Cable make-up

The following cables are used for connection with the servo motor and other models.



Note : Those indicated by broken lines are not available as options.

No.	Product	Model	Description		Application
1)	Motor cable	MR-JRCBL□M-H Refer to (2) in this section	Servo amplifier side connector (Molex make) Connector: 5557-12R-210 Terminal: 5556	Servo motor side connector (Molex make) Connector: 5559-12P-210 Terminal: 5558	IP44 compliant
2)	Motor cable connector set	MR-JRCNM	Servo amplifier side connector (Molex make) Connector: 5557-12R-210 Terminal: 5556	Servo motor side connector (Molex make) Connector: 5559-12P-210 Terminal: 5558	IP44 compliant
3)	Control signal connector set	MR-J2CN1	Servo amplifier side connector (3M or equivalent) Connector: 1020-3000VE Shell kit: 10320-52F0-008	Qty: 2 each	
4)	Junction terminal block cable	MR-J2TBL05M Refer to section 12.1.2.	Junction terminal block side connector (Hirose Electric) Connector: HIF3BA-20D-2.54R	Servo amplifier side connector (3M or equivalent) Connector: 10120-6000EL Shell kit: 10320-3210-000	For junction terminal block connection
5)	Junction terminal block	MR-TB20	Refer to Section 12.1.2.		
6)	Communication cable	MR-JRPC98CBL3M Refer to (4) in this section.	Servo amplifier side connector (Molex make) Connector: 5557-04R-210 Terminal: 5556	Personal computer side connector (Japan Aviation Electronics) Connector: DE-25PF-N Terminal: DE-C2-J9	For connection with PC-98 personal computer
7)	Communication cable	MR-JRPCATCBL3M Refer to (4) in this section.	Servo amplifier side connector (Molex make) Connector: 5557-04R-210 Terminal: 5556	Personal computer side connector (Japan Aviation Electronics) Connector: DE-9SF-N Terminal: DE-C1-J6-S6	For connection with PC-AT-compatible personal computer

(2) Motor cable

> **CAUTION**
> • If you have fabricated the motor cable, connect it correctly. Otherwise, misoperation or explosion may occur.

> **POINT**
> • The encoder cable is not oil resistant.
> • Refer to section 11.3 for the flexing life of the motor cable.

Generally use the encoder cable available as our options. If the required length is not found in the options, fabricate the cable on the customer side.

Servo Motor Model	Motor Cable			Connector Set
	(Note 1) Model	Use for EN/UL Standard	(Note 2) Long flexing life	
HC-AQ0135D to HC-AQ0335D	MR-JRCBL□M-H	O	O	MR-JRCNM

Note: 1. □ indicates the cable length: 2, 5, 10, 20, 30(m).
2. The standard cable has a long flexing life.

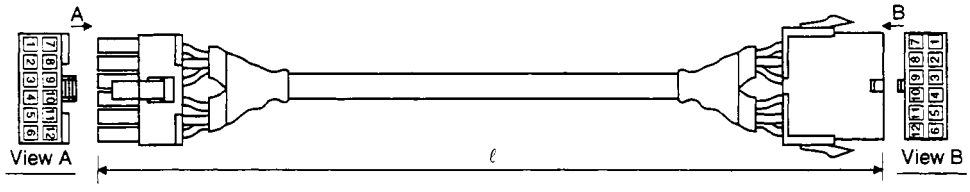
(a) Model explanation

Model: MR-JRCBL□M-□

Long flexing life

Symbol	Cable Length [m]([ft])
2	2(6.5)
5	5(16.4)
10	10(32.8)
20	20(65.6)
30	30(98.4)

(b) Outline drawing

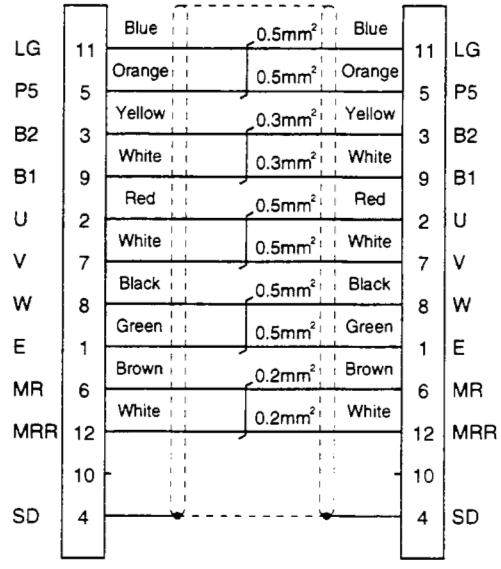


(c) Connection diagram

When fabricating the cable, use the recommended wire (J14B1180) given in Section 12.2.1 and follow the connection diagram shown below. A cable of up to 30m may be fabricated for this connection.

Servo amplifier side
Connector: 5557-12R-210
Terminal :5556

Servo motor side
Connector: 5559-12P-210
Terminal :5558


LG 11 Blue 0.5mm² Blue 11 LG
P5 5 Orange 0.5mm² Orange 5 P5
B2 3 Yellow 0.3mm² Yellow 3 B2
B1 9 White 0.3mm² White 9 B1
U 2 Red 0.5mm² Red 2 U
V 7 White 0.5mm² White 7 V
W 8 Black 0.5mm² Black 8 W
E 1 Green 0.5mm² Green 1 E
MR 6 Brown 0.2mm² Brown 6 MR
MRR 12 White 0.2mm² White 12 MRR
10 10
SD 4 4 SD

(3) Communication cable

POINT
• This cable may not be used with some personal computers. After fully examining the signals of the RS-232C connector, refer to this section and fabricate the cable.

Select the communication cable according to the shape of the RS-232C connector of the personal computer used. When fabricating the cable, refer to the connection diagram in this section.

(a) Fabricating instructions

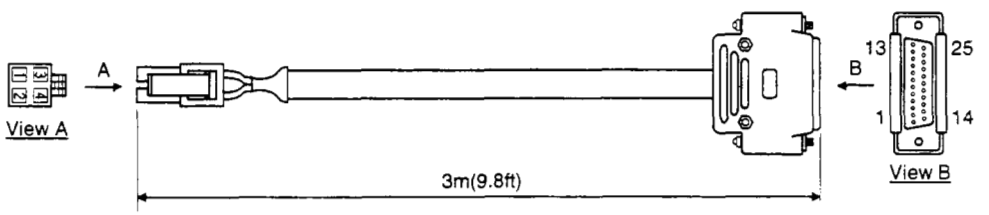
The following must be observed in fabrication:

1) Always use a shielded, multi-core cable and connect the shield with FG securely.

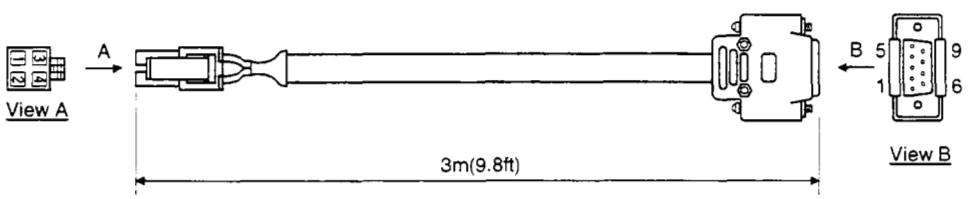
2) The optional communication cable is 3m (10 ft) long. When the cable is fabricated, its maximum length is 15m (49 ft) in offices of good environment with minimal noise.

(b) Outline drawing

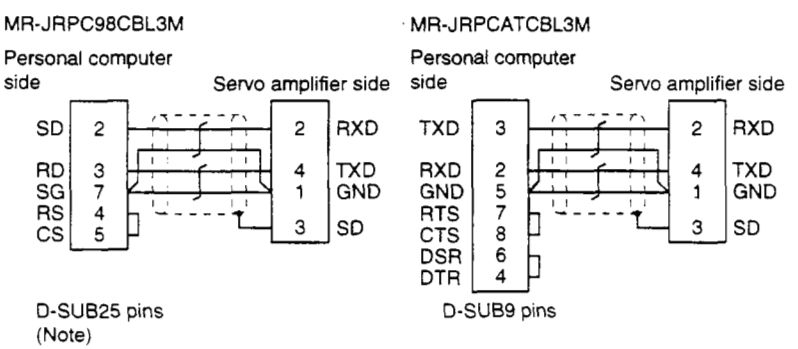
• MR-JRPC98CBL3M



• MR-JRPCATCBL3M



(c) Connection diagram

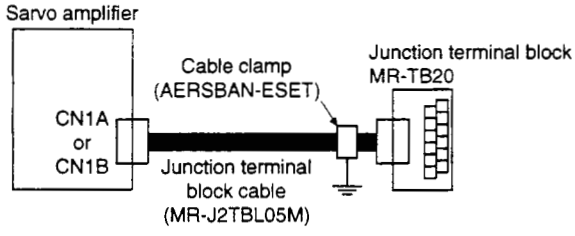


Note: The PC98 Notes having the connector of half-pitch 14 pins are also available. Confirm the shape of the RS-232C connector of the personal computer used.

12.1.2 Junction terminal block (MR-TB20)

(1) How to use the junction terminal block

Always use the junction terminal block (MR-TB20) with the junction terminal block cable (MR-J2TBL05M) as a set. A connection example is shown below:

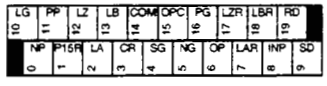


Ground the junction terminal block cable on the junction terminal block side with the standard accessory cable clamp fitting (AERSBAN-ESET). For the use of the cable clamp fitting, refer to Section 12.2.4, (2), (b).

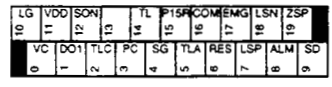
(2) Terminal labels

Among the terminal block labels for the junction terminal block, use the two for the MR-J2-A. When changing the input signals in parameters No. 43 to 48, refer to (4) in this section and Section 3.3 and apply the accessory signal seals to the labels.

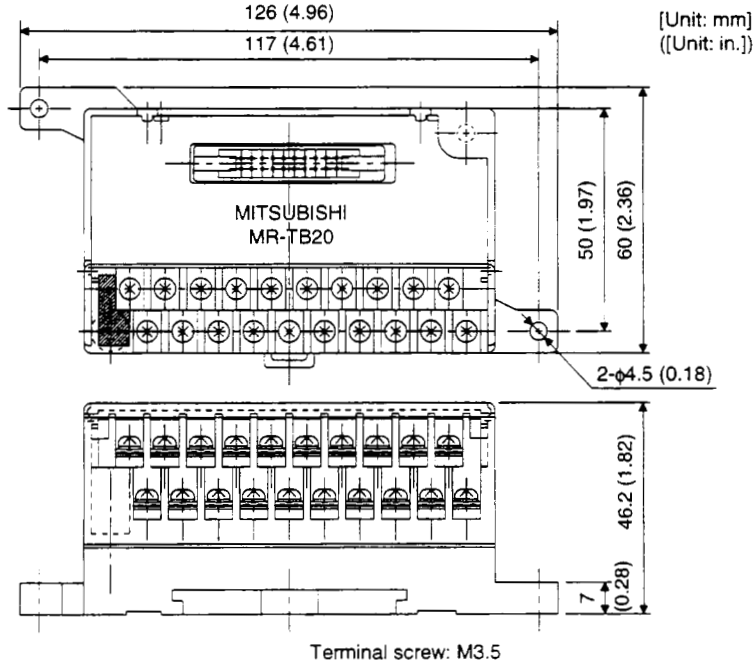
1) For CN1A



2) For CN1B



(3) Outline drawing



Terminal screw: M3.5
Applicable cable: Max. 2mm^2
(Crimping terminal width: 7.2mm (0.283 in) max.)

(4) Junction terminal block cable (MR-J2TBL05M)

Model: MR-J2TBL05M

Cable length: 0.5[m]

Junction terminal block side connector (Hirose Electric)
HIF38A-20D-2.54R (connector)

Servo amplifier side (CN1A CN1B) connector (3M)
1020-6000EL (connector)
10320-3210-000 (shell kit)

(Note) Terminal Block Labels		Junction Terminal Block Terminal No.	Pin No.	Pin No.
For CN1A	For CN1B			
LG	LG	10	B1	1
NP	VC	0	A1	2
PP	VDD	11	B2	3
P15R	DO1	1	A2	4
LZ	SON	12	B3	5
LA	TLC	2	A3	6
LB		13	B4	7
CR	PC	3	A4	8
COM	TL	14	B5	9
SG	SG	4	A5	10
OPC	P15R	15	B6	11
NG	TLA	5	A6	12
PG	COM	16	B7	13
OP	RES	6	A7	14
LZR	EMG	17	B8	15
LAR	LSP	7	A8	16
LBR	LSN	18	B9	17
INP	ALM	8	A9	18
RD	ZSP	19	B10	19
SD	SD	9	A10	20
				Plate

Note: The labels are designed for position control mode. Since the signals change with parameter setting and control mode, use the accessory signal seals to change the signal symbols.

12.1.3 Servo configurations software

The Servo Configuration software uses the communication function of the servo amplifier to perform parameter setting changes, graph display, test operation, etc. on a personal computer.

(1) Specifications

Item	(Note 1) Description
Communication signal	Conforms to RS-232C.
Baudrate	19200bps, 9600bps
(Note 2) Monitor	Batch display, high-speed display, graph display
Alarm	Alarm display, alarm history, data display at alarm occurrence
Diagnostic	External I/O signal display, no-rotation reason display, cumulative power-on time display, software number display, motor information display, tuning data display, automatic VC offset display
Parameters	Data setting, list display, change list display, detailed information display
Test operation	Jog operation, positioning operation, motor-less operation, output signal forced output, program operation in simple language.
File operation	Data read, save, print
Others	Automatic operation, station setting, help display

Note: 1. On some personal computers, this software may not run properly.
2. Minimum resolution changes with the processing speed of the personal computer.

(2) System configuration

(a) Components

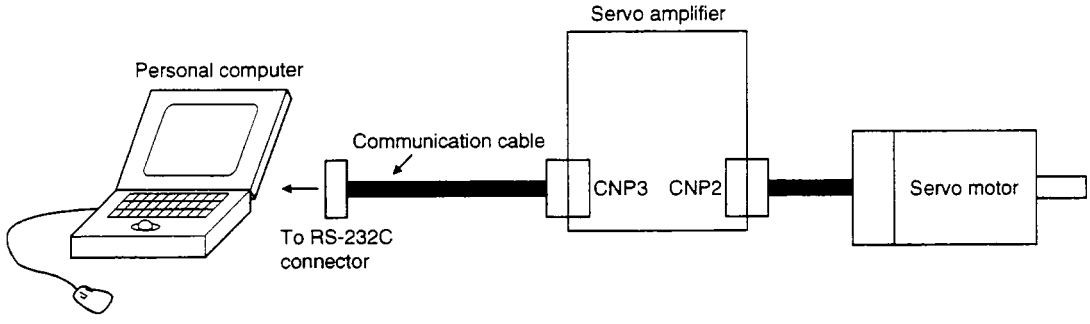
To use this software, the following components are required in addition to the servo amplifier and servo motor:

Model	Description
Personal computer	Which contains a 80386 or higher CPU and on which Windows 3.1/ 95 runs (80486 or higher recommended).Memory: 8MB or more, hard disk: 1MB or more, serial port used.
OS	Windows 3.1/ 95
Display	640×400 or more color or 16-scale monochrome display which can be used with Windows 3.1/ 95.
Keyboard	Which can be connected to the personal computer.
Mouse	Which can be used with Windows 3.1/ 95. Note that a serial mouse is not used.
Printer	Which can be used with Windows 3.1/ 95.
Communication cable	MR-JRPC98CBL3M· MR-JRPCATCBL3M When these cannot be used, refer to (3) Section 12.1.1 and fabricate.
RS-232C/RS-422 converter	Needed to use the RS-422 multidrop communication function of the servo amplifier.

Note: Windows is a trade mark of Microsoft Corporation.

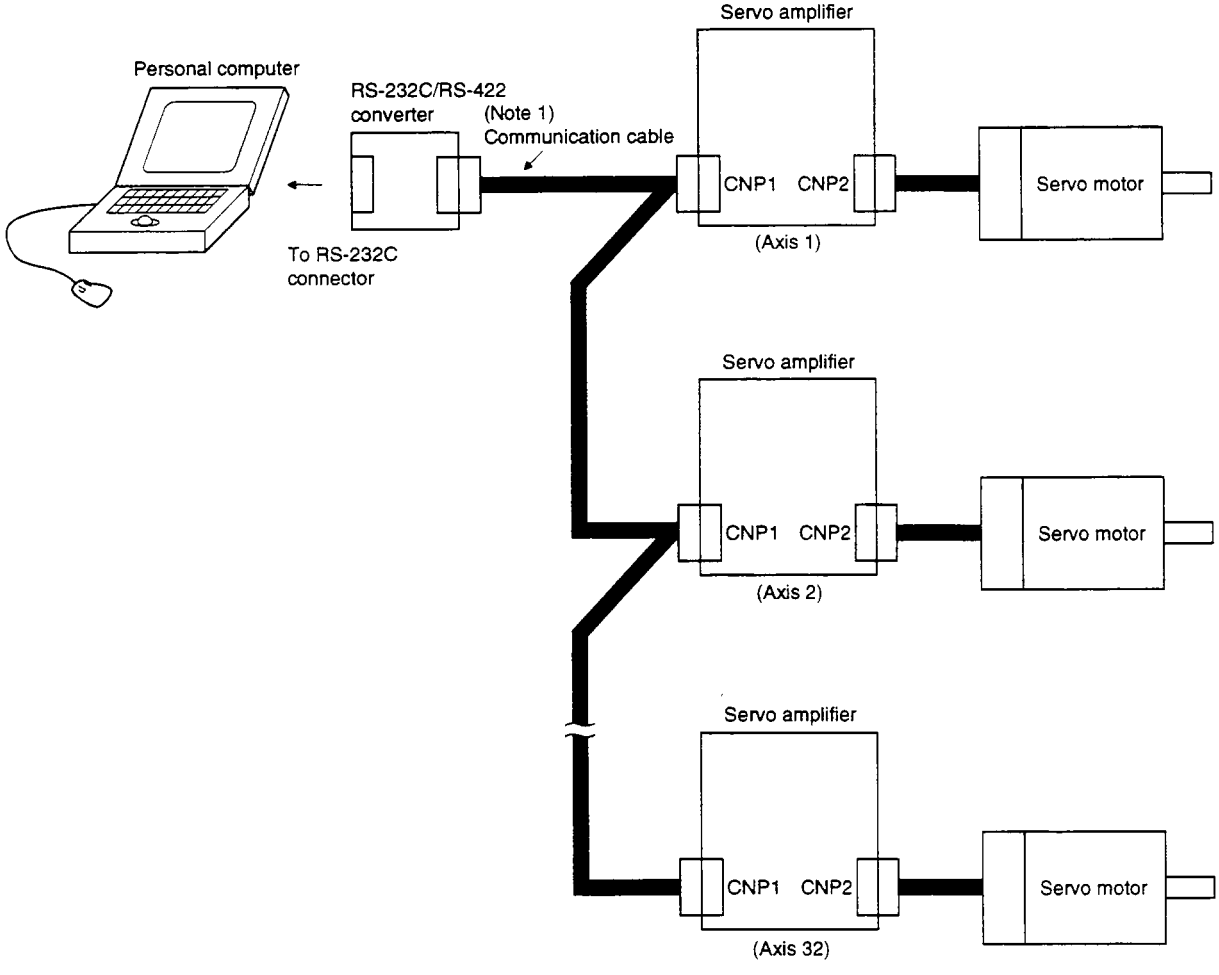
(b) Configuration diagram

1) When using RS-232C



2) When using RS-422

You can make multidrop connection of up to 32 axes.



Note: For cable connection, refer to section 13.1.1.

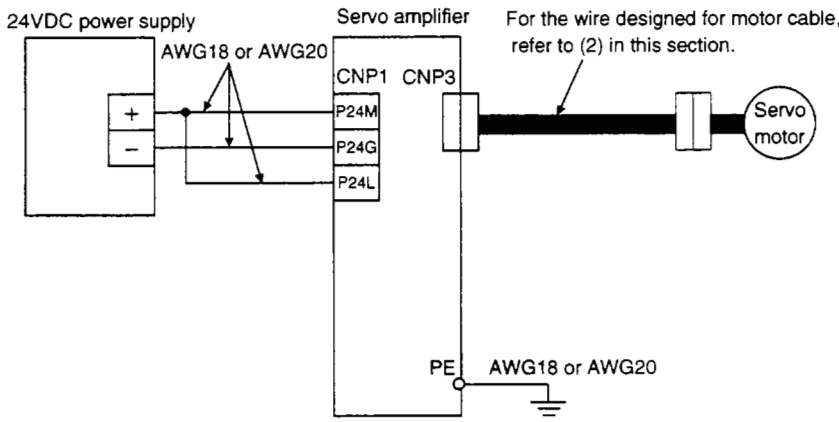
12.2 Auxiliary Equipment

Always use the devices indicated in this section or equivalent. To comply with the EN Standard or UL/C-UL Standard, use the products which conform to the corresponding standard.

12.2.1 Recommended wires

(1) Wires for power supply wiring

The following diagram shows the wires used for wiring. Use the wires given in this section or equivalent.



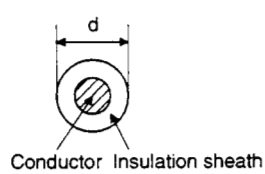
The wires used assume that they are 600V vinyl wires and the wiring distance is 30m max. If the wiring distance is over 30m, choose the wire size in consideration of voltage drop.

(2) Wires for cables

When fabricating a cable, use the wire models given in the following table or equivalent:

Wire Model	Core Size [mm^2]	Number of Cores	Core Insulation Sheath Outline d [mm] (Note 1)	Finishing OD [mm]	Cable Type	Cable Model
J14B1180 (Note 2)	0.2 0.3 0.5	2 (1 pair) 2 (1 pair) 6 (3 pairs)	0.88 1.3 1.53	10.5 to 11	Motor cable	MR-JRCBL□M-H
UL20276AWG28 7pair (BLAC)	0.08	4 (2 pairs)	0.9 to 1.27	5.6	Communication cable	MR-JRPC98CBL□M MR-JRPCATCBL□M

Note: d is as shown below:



12.2.2 Circuit protector

Servo Amplifier	Circuit protector
MR-J2-03A5	CP-30BA

12.2.3 Relays

The following relays should be used with the interfaces:

Interface	Selection Example
Relay used especially for switching on-off input command (interface DI-1) signals	To prevent defective contacts , use a relay for small signal (twin contacts). (Ex.) OMRON : type G2A , MY
Relay used for digital output signals (interface DO-1)	Small relay with 12VDC or 24VDC of 40mA or less (Ex.) OMRON : type MY

12.2.4 Noise reduction techniques

Noises are classified into external noises which enter the servo amplifier to cause it to malfunction and those radiated by the servo amplifier to cause peripheral devices to malfunction. Since the servo amplifier is an electronic device which handles small signals, the following general noise reduction techniques are required.

Also, the servo amplifier can be a source of noise as its outputs are chopped by high carrier frequencies. If peripheral devices malfunction due to noises produced by the servo amplifier, noise suppression measures must be taken. The measures will vary slightly with the routes of noise transmission.

(1) Noise reduction techniques

(a) General reduction techniques

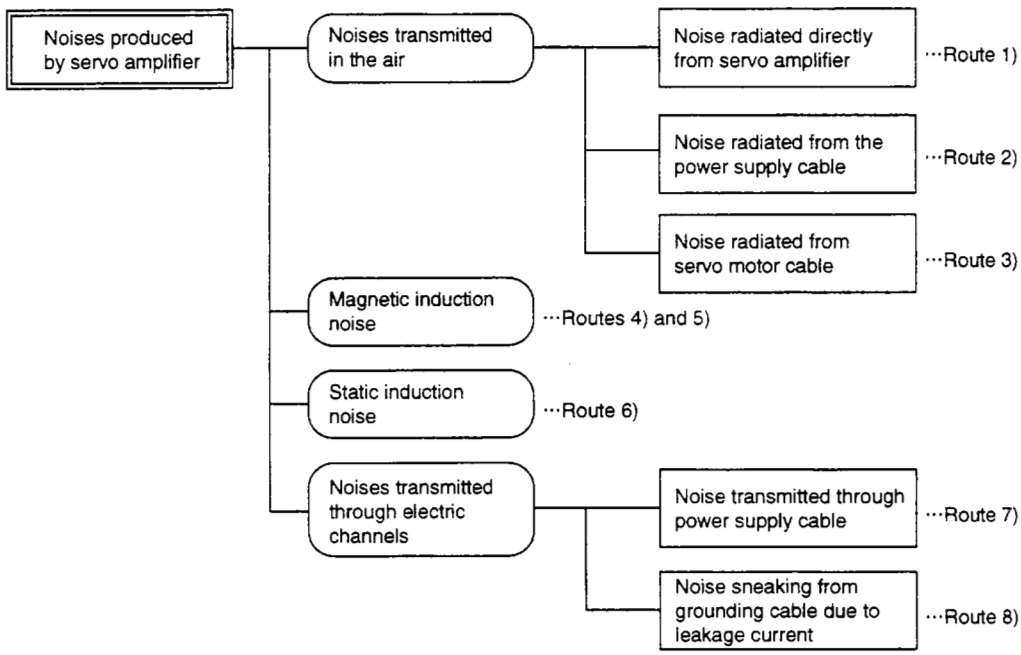
- Avoid laying power lines (input and output cables) and signal cables side by side or do not bundle them together. Separate power lines from signal cables.
- Use shielded, twisted pair cables for connection with the encoder and for control signal transmission, and connect the shield to the SD terminal.
- Ground the servo amplifier, servo motor, etc. together at one point (refer to Section 3.9).

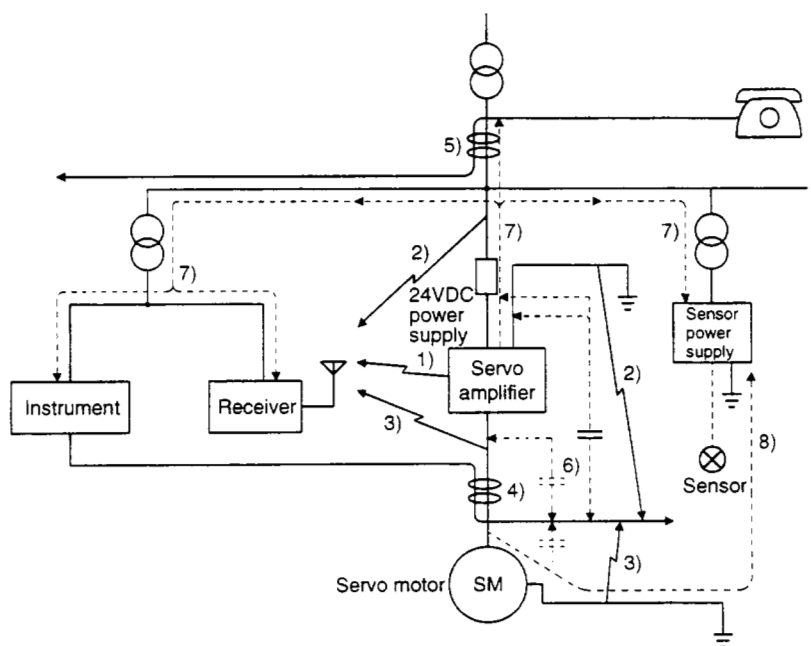
(b) Reduction techniques for external noises that cause the servo amplifier to malfunction

If there are noise sources (such as a magnetic contractor, an electromagnetic brake, and many relays which make a large amount of noise) near the servo amplifier and the servo amplifier may malfunction, the following countermeasures are required.

- Provide surge absorbers on the noise sources to suppress noises.
- Attach data line filters to the signal cables.
- Ground the shields of the encoder connecting cable and the control signal cables with cable clamp fittings.

(c) Techniques for noises radiated by the servo amplifier that cause peripheral devices to malfunction
Noises produced by the servo amplifier are classified into those radiated from the cables connected to the servo amplifier and its main circuits (input and output circuits), those induced electromagnetically or statically by the signal cables of the peripheral devices located near the main circuit cables, and those transmitted through the power supply cables.


Noises produced by servo amplifier
Noises transmitted in the air
Noise radiated directly from servo amplifier
···Route 1)
Noise radiated from the power supply cable
···Route 2)
Noise radiated from servo motor cable
···Route 3)
Magnetic induction noise
···Routes 4) and 5)
Static induction noise
···Route 6)
Noises transmitted through electric channels
Noise transmitted through power supply cable
···Route 7)
Noise sneaking from grounding cable due to leakage current
···Route 8)



Noise Transmission Route	Suppression Techniques
1) 2) 3)	When measuring instruments, receivers, sensors, etc. which handle weak signals and may malfunction due to noise and/or their signal cables are contained in a control box together with the servo amplifier or run near the servo amplifier, such devices may malfunction due to noises transmitted through the air. The following techniques are required. (1) Provide maximum clearance between easily affected devices and the servo amplifier. (2) Provide maximum clearance between easily affected signal cables and the I/O cables of the servo amplifier. (3) Avoid laying the power lines (I/O cables of the servo amplifier) and signal cables side by side or bundling them together. (4) Insert a line noise filter to the I/O cables or a radio noise filter on the input line. (5) Use shielded wires for signal and power cables or put cables in separate metal conduits.
4) 5) 6)	When the power lines and the signal cables are laid side by side or bundled together, magnetic induction noise and static induction noise will be transmitted through the signal cables and malfunction may occur. The following techniques are required. (1) Provide maximum clearance between easily affected devices and the servo amplifier. (2) Provide maximum clearance between easily affected signal cables and the I/O cables of the servo amplifier. (3) Avoid laying the power lines (I/O cables of the servo amplifier) and signal cables side by side or bundling them together. (4) Use shielded wires for signal and power cables or put the cables in separate metal conduits.
7)	When the power supply of peripheral devices is connected to the power supply of the servo amplifier system, noises produced by the servo amplifier may be transmitted back through the power supply cable and the devices may malfunction. The following techniques are required. (1) Insert the radio noise filter on the power cables (I/O cables) of the servo amplifier. (2) Insert the line noise filter on the power cables of the servo amplifier.
8)	When the cables of peripheral devices are connected to the servo amplifier to make a closed loop circuit, leakage current may flow to malfunction the peripheral devices. If so, malfunction may be prevented by disconnecting the grounding cable of the peripheral device.

(2) Noise reduction products

(a) Data line filter

Noise can be prevented by installing a data line filter onto the encoder cable, etc.

Example: Data line filter: ZCAT3035-1330 [TDK]

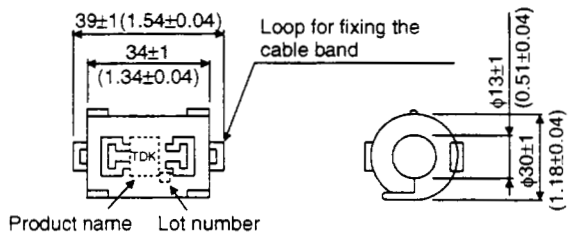
ESD-SR-25 [Tokin]

Impedance specifications (ZCAT3035-1330)

Impedance[Ω]	
10 to 100MHZ	100 to 500MHZ
80	150

The above impedances are reference values and not guaranteed values.

[Unit: mm]([Unit: in.])

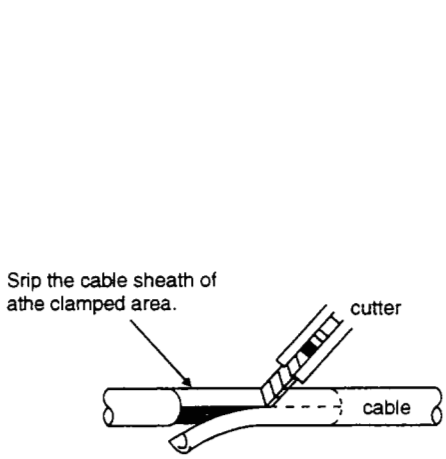


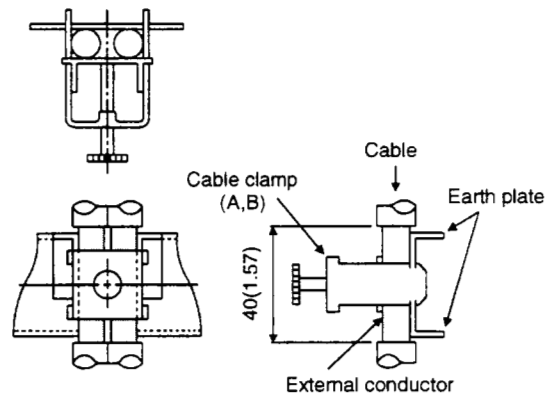
Outline drawing (ZCAT3035-1330)

(b) Cable clamp fitting (AERSBAN-□SET)

Generally, the earth of the shielded cable may only be connected to the connector's SD terminal. However, the effect can be increased by directly connecting the cable to an earth plate as shown below. Install the earth plate near the servo amplifier for the encoder cable. Peel part of the cable sheath to expose the external conductor, and press that part against the earth plate with the cable clamp. If the cable is thin, clamp several cables in a bunch.

The clamp comes as a set with the earth plate.



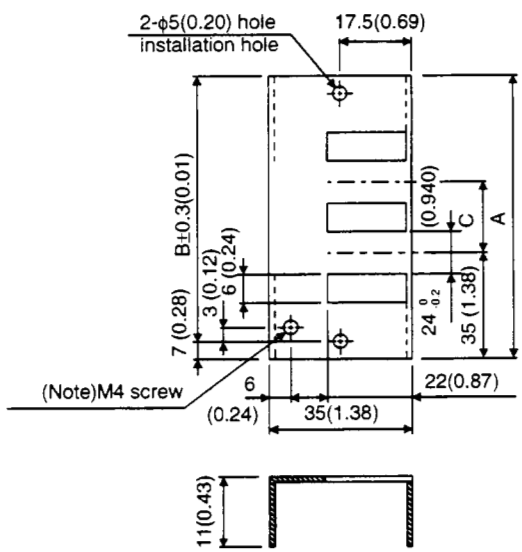


Clamp section diagram

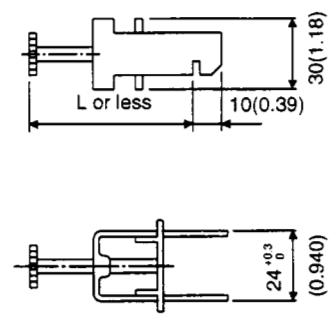
· Outline drawing

[Unit: mm]
([Unit: in.])

Earth plate



Clamp section diagram



Note: Screw hole for grounding. Connect it to the earth plate of the control box.

Type	A	B	C	Accessory Fittings
AERSBAN-DSET	100 (3.94)	86 (3.39)	30 (1.18)	clamp A: 2pcs.
AERSBAN-ESET	70 (2.76)	56 (2.20)		clamp B: 1pc.

Clamp Fitting	L
A	70 (2.76)
B	45 (1.77)

13. COMMUNICATION FUNCTIONS

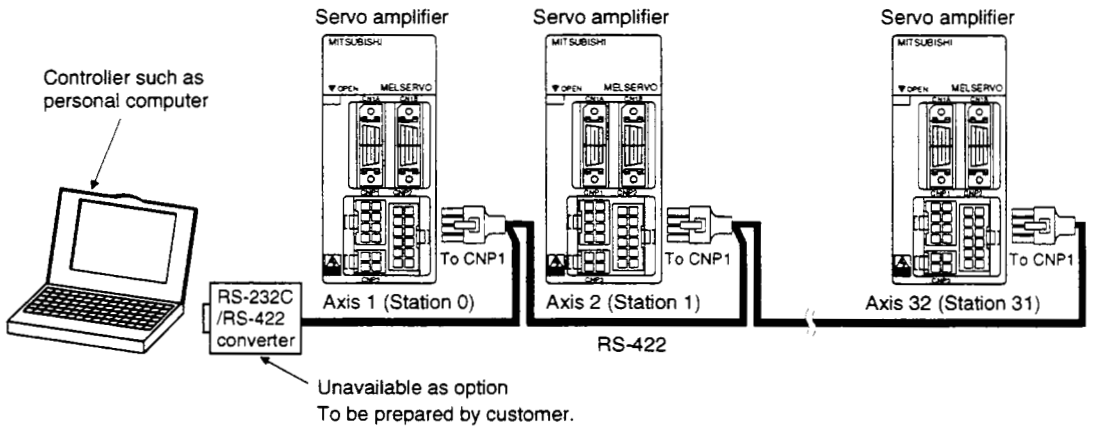
The MR-J2-03A5 has the RS-422 and RS-232C serial communication functions. These functions can be used to perform servo operation, parameter changing, monitor function, etc.
However, the RS-422 and RS-232C communication functions cannot be used together. Select between RS-422 and RS-232C with parameter No.16. (Refer to Section 5.2.5.)
This function is also available for RS-485. Make the same connections, settings, etc. as in RS-422.

13.1 Configuration

13.1.1 RS-422 configuration

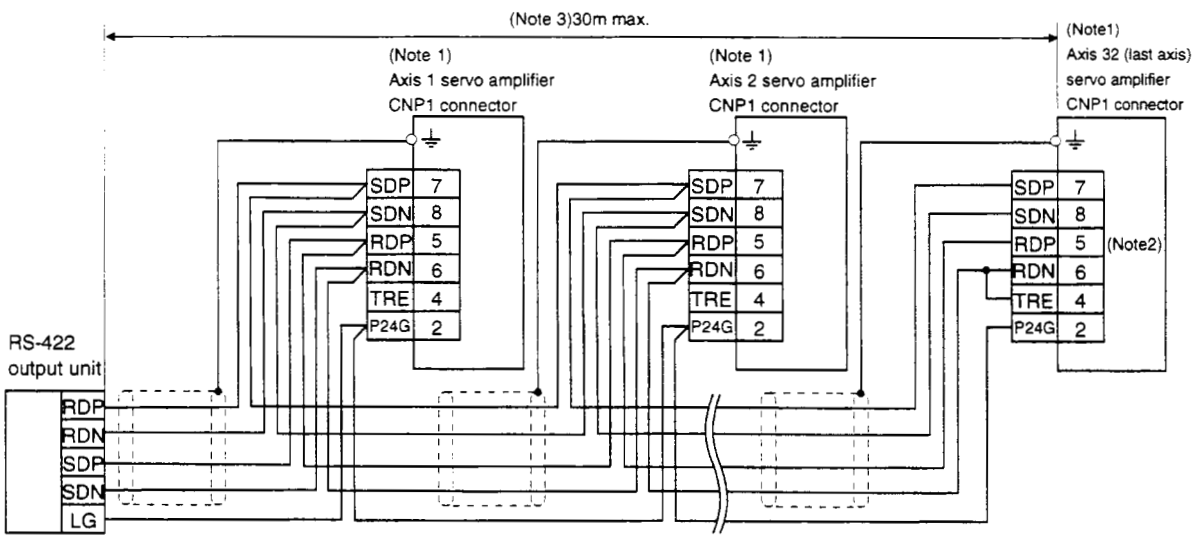
(1) Outline

Up to 32 axes of servo amplifiers from stations 0 to 31 can be operated on the same bus.



(2) Cable connection diagram

Wire as shown below:



Note: 1. Molex's CNP1 connector

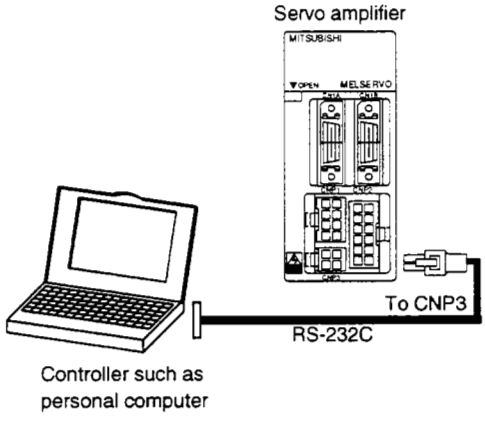
Connector: 5557-08R

2. In the last axis, connect TRE and RDN.
3. Overall distance is 30m max. in the environment where there is a little noise.

13.1.2 RS-232C configuration

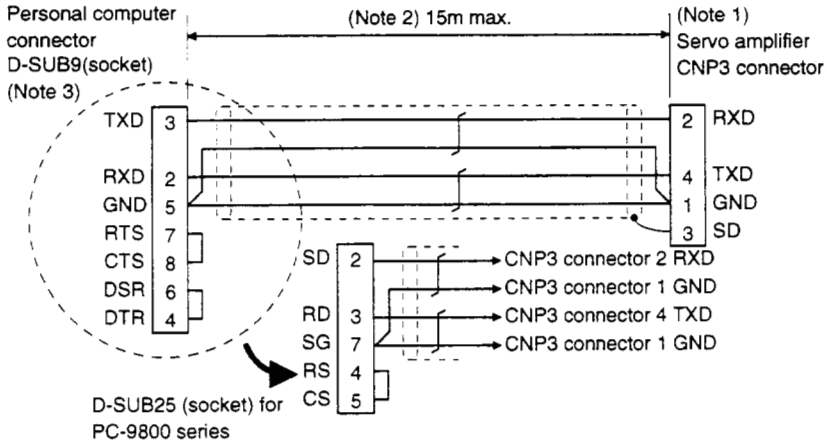
(1) Outline

A single axis of servo amplifier is operated.



(2) Cable connection diagram

Wire as shown below. The communication cable for connection with the personal computer (MR-CPCATCBL3M · MR-CPC98CBL3M) is available. (Refer to Section 12.1.1.)



Note: 1. Molex's CNP3 connector

Connector: 5557-04R-210

Terminal: 5556

2. 15m max. in environment of little noise.

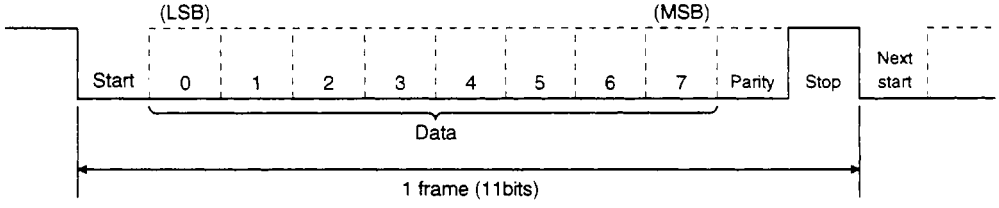
3. For PC-AT compatible controller series.

13.2 Communication Specifications

13.2.1 Communication overview

The MELSERVO-J2 series is designed to send a reply on receipt of an instruction. The device which gives this instruction (e.g. personal computer) is called a master station and the device which sends a reply in response to the instruction (servo amplifier) is called a slave station. When fetching data successively, the master station repeatedly commands the slave station to send data.

Item	Description
Baudrate	4800/9600/19200 asynchronous system
Transfer code	Start bit : 1 bit Data bit : 8 bits Parity bit : 1 bit (even) Stop bit : 1 bit
Transfer protocol	Character system, half-duplex communication system



13.2.2 Parameter setting

When the RS-422/RS-232C communication function is used to operate the servo, set the communication specifications of the servo amplifier in the corresponding parameters.
After setting the values of these parameters, they are made valid by switching power off once, then on again.

(1) Communication baudrate

Choose the communication speed. Match this value to the communication speed of the sending end (master station).

Parameter No. 16

–	–		–

Communication baudrate
0: 9600[bps]
1:19200[bps]
2: 4800[bps]

(2) RS-422/RS-232C serial interface selection

Select the RS-422 or RS-232C communication standard. RS-422 and RS-232C cannot be used together.

Parameter No. 16

–		–	–

RS-422/RS-232C communication standard selection
0: RS-232C used
1: RS-422 used

(3) Communication delay time

Set the time from when the servo amplifier (slave station) receives communication data to when it sends back data. Set "0" to send back data in less than 400 μs or "1" to send back data in 400 μs or more.

Parameter No. 16

	–	–	–

Communication delay time
0: Invalid, reply sent in less than 400μs
1: Valid, reply sent in 400μs or more

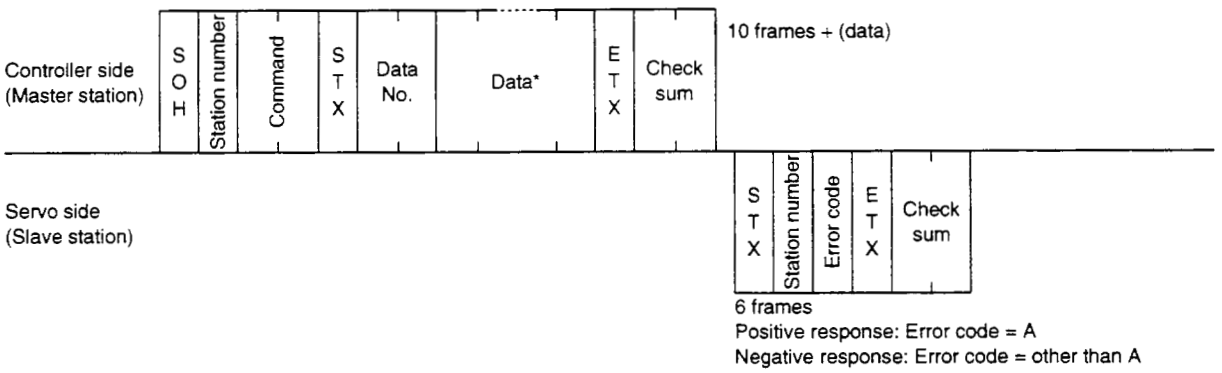
(4) Station number setting

Set the station number of the servo amplifier in parameter No. 15. The setting range is stations 0 to 31.

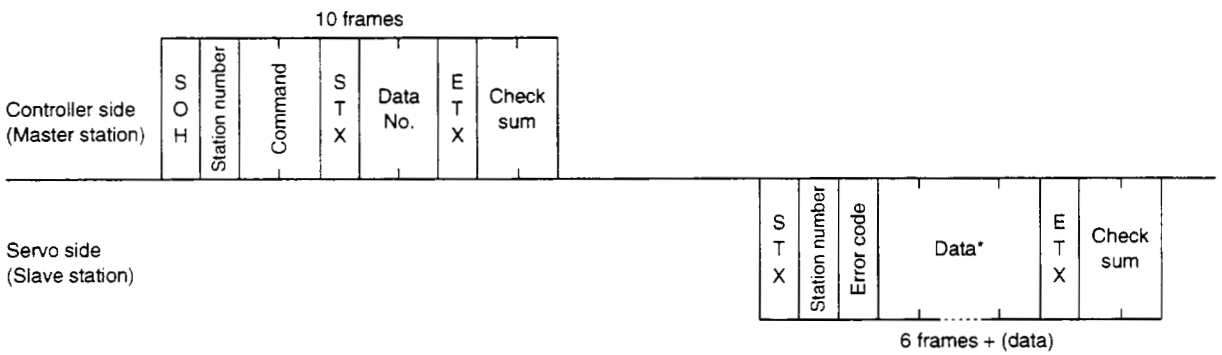
13.3 Protocol

Since up to 32 axes may be connected to the bus, add a station number to the command, data No., etc. to determine the destination servo amplifier of data communication. Set the station number to each servo amplifier using the parameter. Transmission data is valid for the servo amplifier of the specified station number.

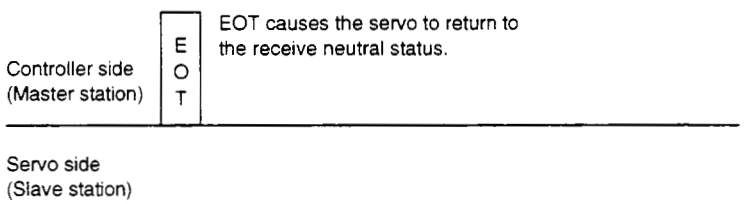
(1) Transmission of data from the controller to the servo



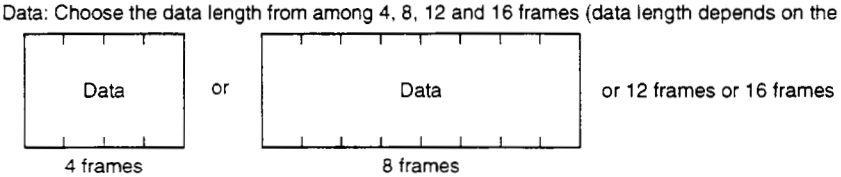
(2) Transmission of data request from the controller to the servo



(3) Recovery of communication status by time-out



* Data: Choose the data length from among 4, 8, 12 and 16 frames (data length depends on the command).



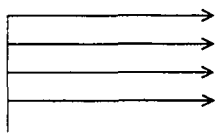
13.4 Character Codes

(1) Control codes

Code Name	Hexadecimal (ASCII code)	Description	Personal Computer Terminal Key Operation (General)
SOH	01H	start of head	ctrl + A
STX	02H	start of text	ctrl + B
ETX	03H	end of text	ctrl + C
EOT	04H	end of transmission	ctrl + D

(2) Codes for data

JIS8 unit codes are used.



b_8	0	0	0	0	0	0	0	0
b_7	0	0	0	0	1	1	1	1
b_6	0	0	1	1	0	0	1	1
b_5	0	1	0	1	0	1	0	1

b_8-b_5	b_4	b_3	b_2	b_1
	0	0	0	0
	0	0	0	1
	0	0	1	0
	0	0	1	1
	0	1	0	0
	0	1	0	1
	0	1	1	0
	0	1	1	1
	1	0	0	0
	1	0	0	1
	1	0	1	0
	1	0	1	1
	1	1	0	0
	1	1	0	1
	1	1	1	0
	1	1	1	1

R \ C	0	1	2	3	4	5	6	7
0	NUL	DLE	Space	0	@	P	`	p
1	SOH	DC_1	!	1	A	Q	a	q
2	STX	DC_2	"	2	B	R	b	r
3	ETX	DC_3	#	3	C	S	c	s
4			$	4	D	T	d	t
5			%	5	E	U	e	u
6			&	6	F	V	f	v
7			'	7	G	W	g	w
8			(	8	H	X	h	x
9			)	9	I	Y	I	y
10			*	:	J	Z	j	z
11			+	;	K	[	k	{
12			,	<	L	¥	l	|
13			-	=	M	]	m	}
14			.	>	N	^	n	~
15			/	?	O	_	o	DEL

(3) Station numbers

You may set 32 station numbers from station 0 to station 31 and the JIS8 unit codes are used to specify the stations.

Station number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
JIS8 code	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Station number	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
JIS8 code	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V

Example: Station number "0" (axis 1)

Transmit "30H" in hexadecimal.

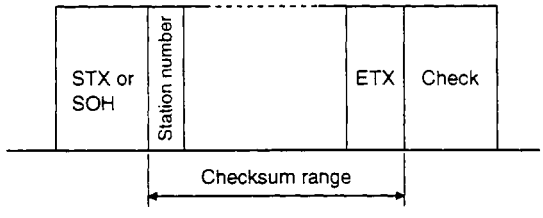
13.5 Error Codes

Error codes are used in the following cases and an error code of single-code length is transmitted.
On receipt of data from the master station, the slave station sends the error code corresponding to that data to the master station. The error code sent in upper-case indicates that the servo is normal and the one in lower-case indicates that an alarm occurred.

Error Code		Error Name	Description	Remarks
Servo normal	Servo alarm			
[A]	[a]	Normal operation	Data transmitted was processed properly.	Positive response
[B]	[b]	Parity error	Parity error occurred in the transmitted data.	Negative response
[C]	[c]	Checksum error	Checksum error occurred in the transmitted data.	
[D]	[d]	Character error	Character not existing in the specifications was transmitted.	
[E]	[e]	Command error	Command not existing in the specifications was transmitted.	
[F]	[f]	Data No. error	Data No. not existing in the specifications was transmitted.	

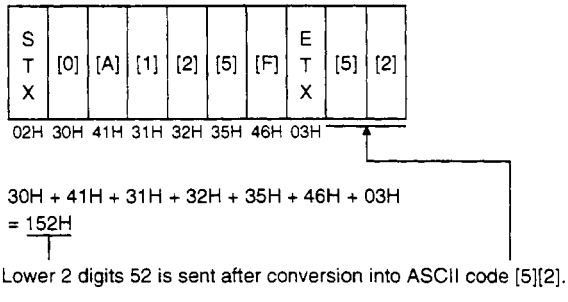
13.6 Checksum

Checksum range



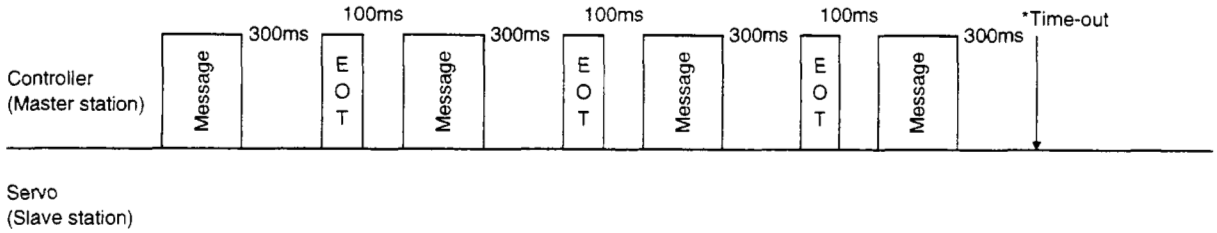
The check sum is a JIS8-coded hexadecimal representing the lower two digits of the sum of JIS8-coded hexadecimal numbers up to ETX, with the exception of the first control code (STX or S0H).

(Example)



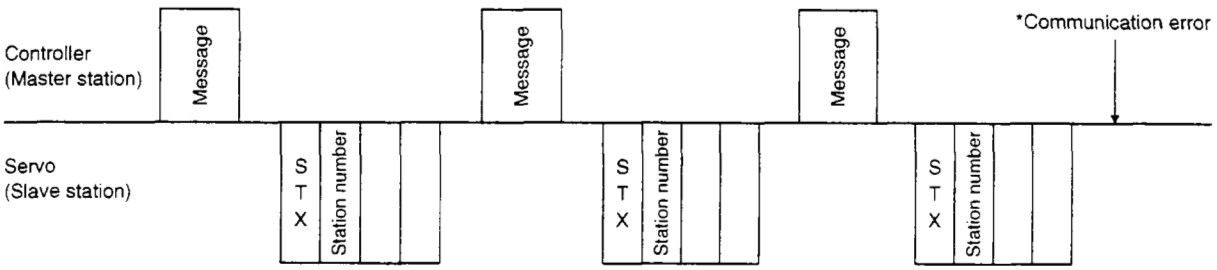
13.7 Time-Out Operation

The master station transmits EOT when the slave station does not start reply operation (STX is not received) 300[ms] after the master station has ended communication operation. 100[ms] after that, the master station retransmits the message. Time-out occurs if the slave station does not answer after the master station has performed the above operation three times. (Communication error)



13.8 Retry Operation

When a fault occurs in communication between the master and slave stations, the error code in the response data from the slave station is a negative response code ([B] to [F], [b] to [f]). In this case, the master station retransmits the message which was sent at the occurrence of the fault (Retry operation). A communication error occurs if the above operation is repeated and results in the error three or more consecutive times.



Similarly, when the master station detects a fault (e.g. checksum, parity) in the response data from the slave station, the master station retransmits the message which was sent at the occurrence of the fault. A communication error occurs if the retry operation is performed three times.

13.9 Initialization

After the slave station is switched on, it cannot reply to communication until the internal initialization processing terminates. Hence, at power-on, ordinary communication should be started after:

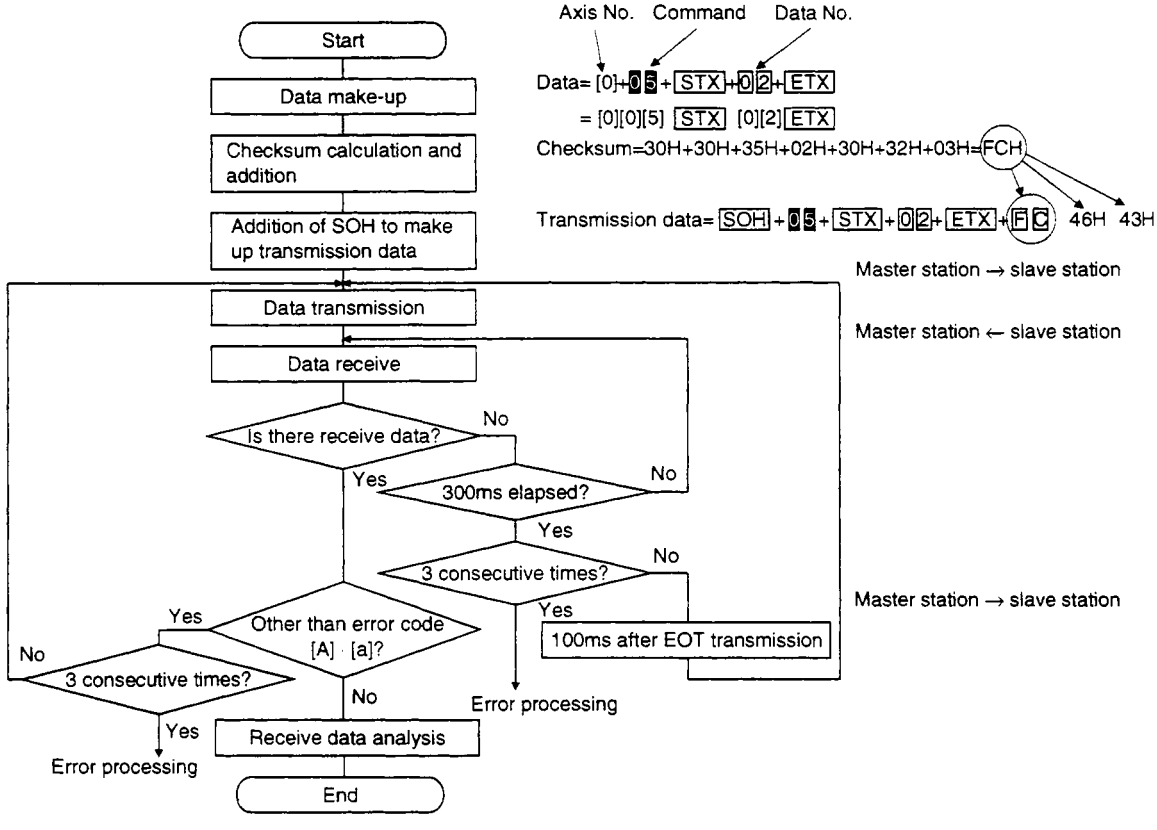
(1) 1s or more time has elapsed after the slave station is switched on; and

(2) Making sure that normal communication can be made by reading the parameter or other data which does not pose any safety problems.

13.10 Communication Procedure Example

The following example reads the set value of parameter No.2 "function selection 1" from the servo amplifier of station 0:

Data Item	Value	Description
Station number	0	Servo amplifier station 0
Command	05	Read command
Data No.	02	Parameter No.2



13.11 Command and Data No. List

13.11.1 Read commands

(1) Status display (Command [0][1])

Command	Data No.	Description	Display Item	Frame Length
[0][1]	[8][0]	Status display data value and processing information	cumulative feedback pulses	12
[0][1]	[8][1]		servo motor speed	12
[0][1]	[8][2]		droop pulses	12
[0][1]	[8][3]		cumulative command pulses	12
[0][1]	[8][4]		command pulse frequency	12
[0][1]	[8][5]		analog speed command voltage analog speed limit voltage	12
[0][1]	[8][6]		analog torque command voltage analog torque limit voltage	12
[0][1]	[8][7]		regenerative load ratio	12
[0][1]	[8][8]		effective load ratio	12
[0][1]	[8][9]		peak load ratio	12
[0][1]	[8][A]		within one-revolution position	12
[0][1]	[8][B]		Multi-revolution counter	12
[0][1]	[8][C]		load inertia moment ratio	12

(2) Parameter (Command [0][5])

Command	Data No.	Description	Frame Length
[0][5]	[0][0] to [3][1]	Current value of each parameter (The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter number.)	8

(3) External I/O signals (Command [1][2])

Command	Data No.	Description	Frame Length
[1][2]	[4][0]	External input pin statuses	8
[1][2]	[C][0]	External output pin statuses	8

(4) Alarm history (Command [3][3])

Command	Data No.	Description	Alarm Occurrence Sequence	Frame Length
[3][3]	[1][0]	Alarm number in alarm history	most recent alarm	4
[3][3]	[1][1]		first alarm in past	4
[3][3]	[1][2]		second alarm in past	4
[3][3]	[1][3]		third alarm in past	4
[3][3]	[1][4]		fourth alarm in past	4
[3][3]	[1][5]		fifth alarm in past	4
[3][3]	[2][0]	Alarm occurrence time in alarm history	most recent alarm	8
[3][3]	[2][1]		first alarm in past	8
[3][3]	[2][2]		second alarm in past	8
[3][3]	[2][3]		third alarm in past	8
[3][3]	[2][4]		fourth alarm in past	8
[3][3]	[2][5]		fifth alarm in past	8

(5) Current alarm (Command [0][2] · [3][5])

Command	Data No.	Description	Frame Length
[0][2]	[0][0]	Current alarm number	4

Command	Data No.	Description	Display Item	Frame Length
[3][5]	[8][0]	Status display data value and processing information at alarm occurrence	cumulative feedback pulses	12
[3][5]	[8][1]		servo motor speed	12
[3][5]	[8][2]		droop pulses	12
[3][5]	[8][3]		cumulative command pulses	12
[3][5]	[8][4]		command pulse frequency	12
[3][5]	[8][5]		analog speed command voltage analog speed limit voltage	12
[3][5]	[8][6]		analog torque command voltage analog torque limit voltage	12
[3][5]	[8][7]		regenerative load ratio	12
[3][5]	[8][8]		effective load ratio	12
[3][5]	[8][9]		peak load ratio	12
[3][5]	[8][A]		within one-revolution position	12
[3][5]	[8][B]		Multi-revolution counter	12
[3][5]	[8][C]		load inertia moment ratio	12

(6) Others

Command	Data No.	Description	Frame Length
[0][2]	[9][0]	Servo motor end pulse unit absolute position	8
[0][2]	[9][1]	Command unit absolute position	8
[0][2]	[7][0]	Software version	16

13.11.2 Write commands

(1) Status display (Command [8][1])

Command	Data No.	Description	Setting Range	Frame Length
[8][1]	[0][0]	Status display data clear	1EA5	4

(2) Parameter (Command [8][4])

Command	Data No.	Description	Setting Range	Frame Length
[8][4]	[0][0] to [3][1]	Each parameter write (The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter number.)	Depends on the parameter.	8

(3) Alarm history (Command [8][2])

Command	Data No.	Description	Setting Range	Frame Length
[8][2]	[2][0]	Alarm history clear	1EA5	4

(4) Current alarm (Command [8][2])

Command	Data No.	Description	Setting Range	Frame Length
[8][2]	[0][0]	Alarm reset	1EA5	4

(5) Operation mode selection (command [8][B])

Command	Data No.	Description	Setting Range	Frame Length
[8][B]	[0][0]	Operation mode changing 0000: Exit from test operation mode 0001: Jog operation 0002: Positioning operation 0003: Motor-less operation 0004: DO forced output (output signal forced output)	0000 to 0004	4

(6) External input signal disable (command [9][0])

Command	Data No.	Description	Setting Range	Frame Length
[9][0]	[0][0]	Turns off the external input signals (DI), external analog input signals and pulse train inputs with the exception of EMG, LSP and LSN, independently of the external ON/OFF statuses.	1EA5	4
[9][0]	[0][3]	Changes the external output signals (DO) into the value of command [8][B] or command [A][0] + data No. [0][1].	1EA5	4
[9][0]	[1][0]	Enables the disabled external input signals (DI), external analog input signals and pulse train inputs with the exception of EMG, LSP and LSN.	1EA5	4
[9][0]	[1][3]	Enables the disabled external output signals (DO).	1EA5	4

(7) Data for test operation mode (command [9][2] · [A][0])

Command	Data No.	Description	Setting Range	Frame Length
[9][2]	[0][0]	Input signal for test operation		8
[9][2]	[A][0]	Forced output from signal pin		8

Command	Data No.	Description	Setting Range	Frame Length
[A][0]	[1][0]	Writes the speed of the test operation mode (jog operation, positioning operation).	0000 to 7FFF	4
[A][0]	[1][1]	Writes the acceleration/deceleration time constant of the test operation mode (jog operation, positioning operation).	00000000 to 7FFFFFFF	8
[A][0]	[1][2]	Clears the acceleration/deceleration time constant of the test operation mode (jog operation, positioning operation).	1EA5	4
[A][0]	[1][3]	Writes the moving distance (in pulses) of the test operation mode (jog operation, positioning operation).	80000000 to 7FFFFFFF	8
[A][0]	[1][5]	Temporary stop command of the test operation mode (jog operation, positioning operation)	1EA5	4

13.12 Detailed Explanations of Commands

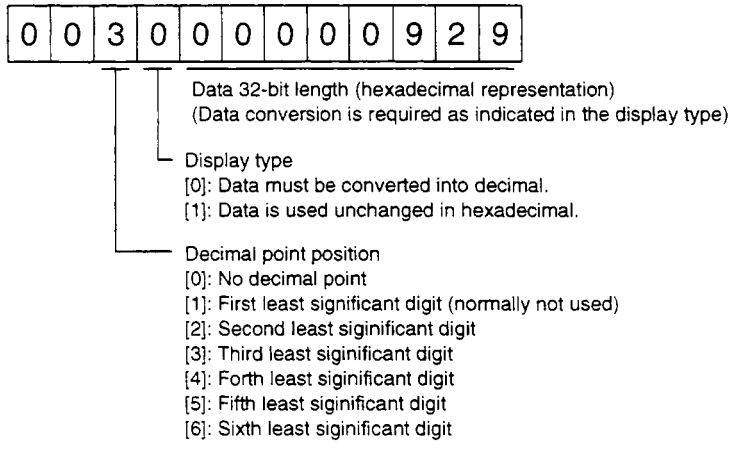
13.12.1 Data processing

When the master station transmits a command + data No. or a command + data No. + data to a slave station, the servo amplifier returns a reply or data according to the purpose.
When numerical values are represented in these send data and receive data, they are represented in decimal, hexadecimal, etc.
Therefore, data must be processed according to the application.
Since whether data must be processed or not and how to process data depend on the monitoring, parameters, etc., follow the detailed explanation of the corresponding command.
The following methods are how to process send and receive data when reading and writing data.

(1) Processing the read data

When the display type is 0, the eight-character data is converted from hexadecimal to decimal and a decimal point is placed according to the decimal point position information.
When the display type is 1, the eight-character data is used unchanged.

The following example indicates how to process the receive data "003000000929" given to show.
The receive data is as follows.

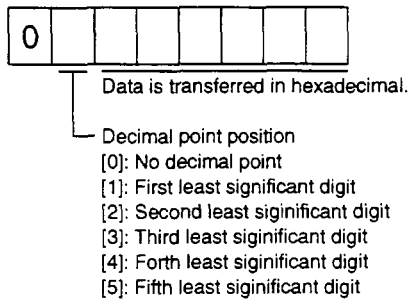

0 0 3 0 0 0 0 0 0 9 2 9
Data 32-bit length (hexadecimal representation)
(Data conversion is required as indicated in the display type)
Display type
[0]: Data must be converted into decimal.
[1]: Data is used unchanged in hexadecimal.
Decimal point position
[0]: No decimal point
[1]: First least significant digit (normally not used)
[2]: Second least siginificant digit
[3]: Third least siginificant digit
[4]: Forth least siginificant digit
[5]: Fifth least siginificant digit
[6]: Sixth least siginificant digit

Since the display type is "0" in this case, the hexadecimal data is converted into decimal.
00000929H→2345
As the decimal point position is "3", a decimal point is placed in the third least significant digit.
Hence, "23.45" is displayed.

(2) Writing the processed data

When the data to be written is handled as decimal, the decimal point position must be specified. If it is not specified, the data cannot be written. When the data is handled as hexadecimal, specify "0" as the decimal point position.

The data to be sent is the following value.


0
Data is transferred in hexadecimal.
Decimal point position
[0]: No decimal point
[1]: First least significant digit
[2]: Second least siginificant digit
[3]: Third least siginificant digit
[4]: Forth least siginificant digit
[5]: Fifth least siginificant digit

By way of example, here is described how to process the set data when a value of "15.5" is sent.

Since the decimal point position is the second digit, the decimal point position data is "2".

As the data to be sent is hexadecimal, the decimal data is converted into hexadecimal.

155→9B

Hence, "0200009B" is transmitted.

13.12.2 Status display

(1) Status display data read

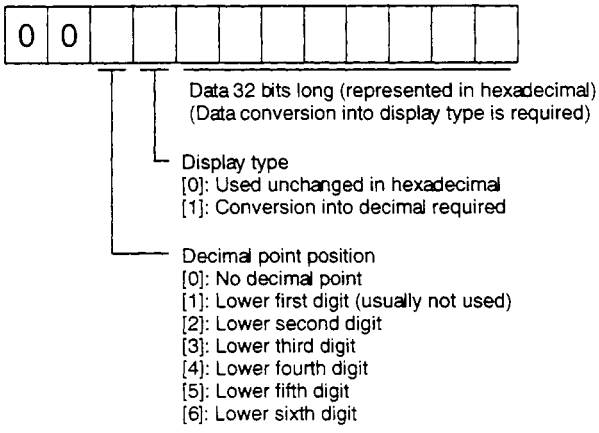
When the master station transmits the data No. (refer to the following table for assignment) to the slave station, the slave station sends back the data value and data processing information.

1) Transmission

Transmit command [0][1] and the data No. corresponding to the status display item to be read. Refer to Section 13.11.1.

2) Reply

The slave station sends back the status display data requested.


0 0
Data 32 bits long (represented in hexadecimal)
(Data conversion into display type is required)
Display type
[0]: Used unchanged in hexadecimal
[1]: Conversion into decimal required
Decimal point position
[0]: No decimal point
[1]: Lower first digit (usually not used)
[2]: Lower second digit
[3]: Lower third digit
[4]: Lower fourth digit
[5]: Lower fifth digit
[6]: Lower sixth digit

(2) Status display data clear

The cumulative feedback pulse data of the status display is cleared. Send this command immediately after reading the status display item. The data of the status display item transmitted is cleared to zero.

Command	Data No.	Data
[8][1]	[0][0]	[1][E][A][5]

For example, after sending command [0][1] and data No. [8][0] and receiving the status display data, send command [8][1], data No. [0][0] and data [1EA5] to clear the cumulative feedback pulse value to zero.

13.12.3 Parameter

(1) Parameter read

Read the parameter setting.

1) Transmission

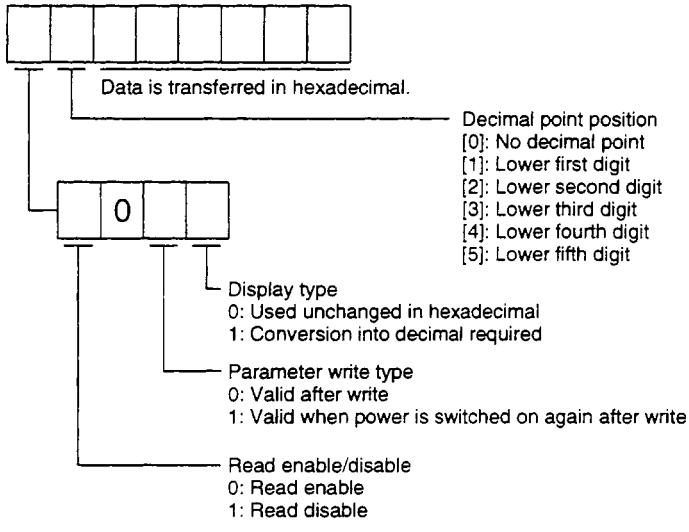
Transmit command [0][5] and the data No. corresponding to the parameter No.

The data No. is expressed in hexadecimal equivalent of the data No. value corresponds to the parameter number.

Command	Data No.
[0][5]	[0][0] to [3][1]

2) Reply

The slave station sends back the data and processing information of the requested parameter No..



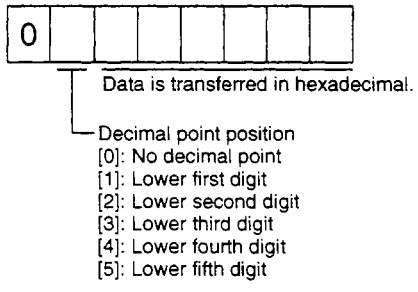
Enable/disable information changes according to the setting of parameter No.19 "parameter write inhibit". When the enable/disable setting is read disable, ignore the parameter data part and process it as unreadable.

(2) Parameter write

POINT
• The number of parameter write times is restricted to 100,000 times.

Write the parameter setting.
Write the value within the setting range. Refer to Section 5.1 for the setting range.
Transmit command [8][4], the data No., and the set data.
The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter number.
When the data to be written is handled as decimal, the decimal point position must be specified. If it is not specified, data cannot be written. When the data is handled as hexadecimal, specify 0 as the decimal point position.
Write the data after making sure that it is within the upper/lower limit value range given in Section 5.1.2. Read the parameter data to be written, confirm the decimal point position, and create transmission data to prevent error occurrence. On completion of write, read the same parameter data to verify that data has been written correctly.

Command	Data No.	Set Data
[8][4]	[0][0] to [3][1]	See below.



13.12.4 External I/O pin statuses (DIO diagnosis)

(1) External input pin status read

Read the ON/OFF statuses of the external input pins.

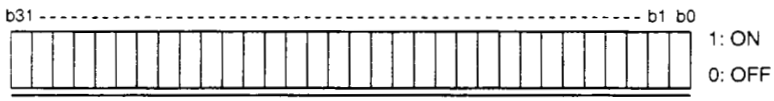
(a) Transmission

Transmit command [1][2] and data No. [4][0].

Command	Data No.
[1][2]	[4][0]

(b) Reply

The ON/OFF statuses of the input pins are sent back.



Command of each bit is transmitted to the master station as hexadecimal data.

bit	External Input Pin
0	CN1B-16
1	CN1B-17
2	CN1B-15
3	CN1B-5
4	CN1B-14
5	CN1A-8
6	CN1B-7
7	CN1B-8

bit	External Input Pin
8	CN1B-9
9	
10	
11	
12	
13	
14	
15	

bit	External Input Pin
16	
17	
18	
19	
20	
21	
22	
23	

bit	External Input Pin
24	
25	
26	
27	
28	
29	
30	
31	

(2) External output pin status read

Read the ON/OFF statuses of the external output pins.

(a) Transmission

Transmit command [1][2] and data No. [C][0].

Command	Data No.
[1][2]	[C][0]

(b) Reply

The slave station sends back the ON/OFF statuses of the output pins.

Command of each bit is transmitted to the master station as hexadecimal data.

bit	External Output Pin
0	CN1A-19
1	CN1A-18
2	CN1B-19
3	CN1B-6
4	CN1B-4
5	CN1B-18
6	CN1A-14
7	

bit	External Output Pin
8	
9	
10	
11	
12	
13	
14	
15	

bit	External Output Pin
16	
17	
18	
19	
20	
21	
22	
23	

bit	External Output Pin
24	
25	
26	
27	
28	
29	
30	
31	

13.12.5 Disable/enable of external I/O signals (DIO)

Inputs can be disabled independently of the external I/O signal ON/OFF. When inputs are disabled, the input signals are recognized as follows. Among the external input signals, EMG, LSP and LSN cannot be disabled.

Signal	Status
External input signals (DI)	OFF
External analog input signals	0V
Pulse train inputs	None

(1) Disabling/enabling the external input signals (DI), external analog input signals and pulse train inputs with the exception of EMG, LSP and LSN.
Transmit the following communication commands:
(a) Disable

Command	Data No.	Data
[9][0]	[0][0]	1EA5

(b) Enable

Command	Data No.	Data
[9][0]	[1][0]	1EA5

(2) Disabling/enabling the external output signals (DO)
Transmit the following communication commands:
(a) Disable

Command	Data No.	Data
[9][0]	[0][3]	1EA5

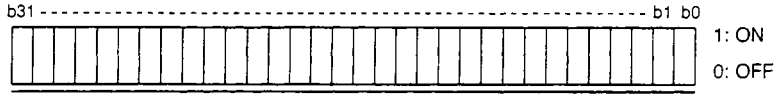
(b) Enable

Command	Data No.	Data
[9][0]	[1][3]	1EA5

13.12.6 External input signal ON/OFF (Test operation)

Each input signal can be turned on/off for test operation. Turn off the external input signals.
Send command [9] [2], data No. [0] [0] and data.

Command	Data No.	Set Data
[9] [2]	[0] [0]	See below



Command of each bit is transmitted to the slave station as hexadecimal data.

bit	Signal Abbreviation	bit	Signal Abbreviation	bit	Signal Abbreviation	bit	Signal Abbreviation
0	SON	8		16		24	
1	LSP	9		17		25	
2	LSN	10		18		26	
3	TL	11		19		27	
4		12		20		28	
5	PC	13		21		29	
6	RES	14		22		30	
7	CR	15		23		31	

13.12.7 Test operation mode

(1) Instructions for test operation mode

The test operation mode must be executed in the following procedure. If communication is interrupted for longer than 0.5s during test operation, the servo amplifier causes the motor to be decelerated to a stop and servo-locked. To prevent this, continue communication without a break, e.g. monitor the status display.

(a) Execution of test operation

1) Turn off all external input signals.

2) Disable the external input signals.

Command	Data No.	Data
[9][0]	[0][0]	1EA5

3) Choose the test operation mode.

Command	Data No.	Transmission Data	Selection of Test Operation Mode
[8][B]	[0][0]	0000	Test operation mode cancel
[8][B]	[0][0]	0001	Jog operation
[8][B]	[0][0]	0002	Positioning operation
[8][B]	[0][0]	0003	Motor-less operation
[8][B]	[0][0]	0004	DO forced output

4) Set the data needed for test operation.

5) Start.

6) Continue communication using the status display or other command.

(b) Termination of test operation

To terminate the test operation mode, complete the corresponding operation and:

1) Clear the test operation acceleration/deceleration time constant.

Command	Data No.	Data
[A][0]	[1][2]	1EA5

2) Cancel the test operation mode.

Command	Data No.	Data
[8][B]	[0][0]	0000

3) Enable the disabled external input signals.

Command	Data No.	Data
[9][0]	[1][0]	1EA5

(2) Jog operation

Transmit the following communication commands:

(a) Setting of jog operation data

Item	Command	Data No.	Data
Speed	[A][0]	[1][0]	Write the speed [r/min] in hexadecimal.
Acceleration/deceleration time constant	[A][0]	[1][1]	Write the acceleration/deceleration time constant [ms] in hexadecimal.

(b) Start

Turn on the external input signals SON and ST1/ST2 by using command [9][2] + data No. [0][0].

Item	Command	Data No.	Data
Forward rotation start	[9][2]	[0][0]	00000801: Turns on SON and ST1.
Reverse rotation start	[9][2]	[0][0]	00001001: Turns on SON and ST2.

(3) Positioning operation

Transmit the following communication commands:

(a) Setting of positioning operation data

Item	Command	Data No.	Data
Speed	[A][0]	[1][0]	Write the speed [r/min] in hexadecimal.
Acceleration/deceleration time constant	[A][0]	[1][1]	Write the acceleration/deceleration time constant [ms] in hexadecimal.
Moving distance	[A][0]	[1][3]	Write the moving distance [pulse] in hexadecimal.

(b) Start

Turn on the external input signals SON and ST1/ST2 by using command [9][2] + data No. [0][0].

Item	Command	Data No.	Data
Forward rotation start	[9][2]	[0][0]	00000801: Turns on SON and ST1.
Reverse rotation start	[9][2]	[0][0]	00001001: Turns on SON and ST2.

(c) Temporary stop

A temporary stop can be made during positioning operation.

Command	Data No.	Data
[A][0]	[1][5]	1EA5

Retransmit the same communication commands as at the start time to resume operation.

To stop positioning operation after a temporary stop, retransmit the temporary stop communication command. The remaining moving distance is then cleared.

13.12.8 Output signal pin ON/OFF (DO forced output)

In the test operation mode, the output signal pins can be turned on/off independently of the servo status. Using command [9][0], disable the output signals in advance.

(1) Choosing DO forced output in test operation mode

Transmit command [8][B] + data No. [0][0] + data "0004" to choose DO forced output.

0	0	0	4

Selection of test operation mode
4: DO forced output (output signal forced output)

(2) External output signal ON/OFF

Transmit the following communication commands:

Command	Data No.	Setting Data
[9][2]	[A][0]	See below.

b31 ---------- b1 b0

1: ON
0: OFF

Command of each bit is sent to the slave station in hexadecimal.

bit	External Output Pin	bit	External Output Pin	bit	External Output Pin	bit	External Output Pin
0	CN1A-19	8		16		24	
1	CN1A-18	9		17		25	
2	CN1B-19	10		18		26	
3	CN1B-6	11		19		27	
4	CN1B-4	12		20		28	
5	CN1B-18	13		21		29	
6	CN1A-14	14		22		30	
7		15		23		31	

13.12.9 Alarm history

(1) Alarm No. read

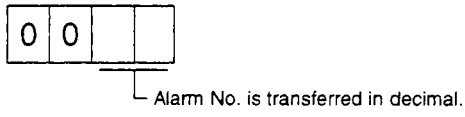
Read the alarm No. which occurred in the past. The alarm numbers and occurrence times of No. 0 (last alarm) to No. 5 (sixth alarm in the past) are read.

(a) Transmission

Send command [3][3] and data No. [1][0] to [1][5]. Refer to Section 13.11.1.

(b) Reply

The alarm No. corresponding to the data No. is provided.



For example, "0032" means A. 32 and "00FF" means A. _ (no alarm).

(2) Alarm occurrence time read

Read the occurrence time of alarm which occurred in the past.

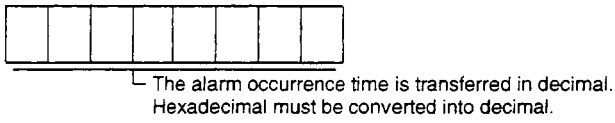
The alarm occurrence time corresponding to the data No. is provided in terms of the total time beginning with operation start, with the minute unit omitted.

(a) Transmission

Send command [3][3] and data No. [2][0] to [2][5].

Refer to Section 13.11.1.

(b) Reply



For example, data [0][1][F][5] means that the alarm occurred in 501 hours after start of operation.

(3) Alarm history clear

Erase the alarm history.

Send command [8][2] and data No. [2][0].

Command	Data No.	Data
[8][2]	[2][0]	[1][E][A][5]

13.12.10 Current alarm

(1) Current alarm read

Read the alarm No. which is occurring currently.

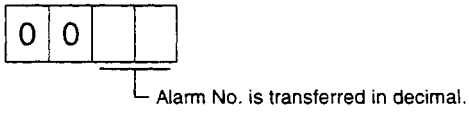
(a) Transmission

Send command [0][2] and data No. [0][0].

Command	Data No.
[0][2]	[0][0]

(b) Reply

The slave station sends back the alarm currently occurring.



For example, "0032" means A. 32 and "00FF" means A. _ (no alarm).

(2) Read of the status display at alarm occurrence

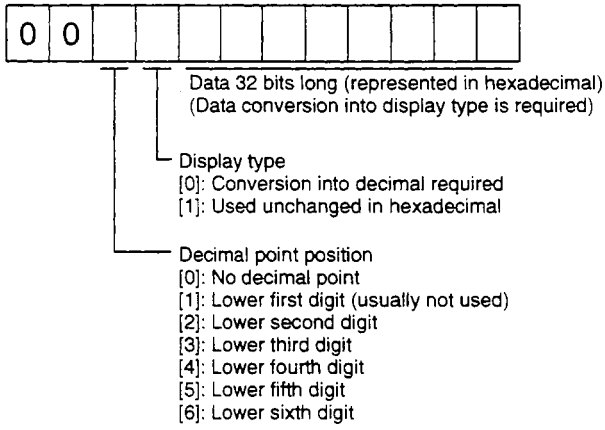
Read the status display data at alarm occurrence. When the data No. corresponding to the status display item is transmitted, the data value and data processing information are sent back.

(a) Transmission

Send command [3][5] and any of data No. [8][0] to [8][E] corresponding to the status display item to be read. Refer to Section 13.11.1.

(b) Reply

The slave station sends back the requested status display data at alarm occurrence.


0 0
Data 32 bits long (represented in hexadecimal)
(Data conversion into display type is required)
Display type
[0]: Conversion into decimal required
[1]: Used unchanged in hexadecimal
Decimal point position
[0]: No decimal point
[1]: Lower first digit (usually not used)
[2]: Lower second digit
[3]: Lower third digit
[4]: Lower fourth digit
[5]: Lower fifth digit
[6]: Lower sixth digit

(3) Current alarm clear

As by the entry of the RES signal, reset the servo amplifier alarm to make the servo amplifier ready to operate. After removing the cause of the alarm, reset the alarm with no command entered.

Command	Data No.	Data
[8][2]	[0][0]	[1][E][A][5]

13.12.11 Other commands

(1) Servo motor end pulse unit absolute position

Read the absolute position in the servo motor end pulse unit.

(a) Transmission

Send command [0][2] and data No. [9][0].

Command	Data No.
[0][2]	[9][0]

(b) Reply

The slave station sends back the requested servo motor end pulses.

Absolute value is sent back in hexadecimal in the servo motor end pulse unit.
(Must be converted into decimal)

For example, data "000186A0" is 100000 [pulse] in the motor end pulse unit.

(2) Command unit absolute position

Read the absolute position in the command unit.

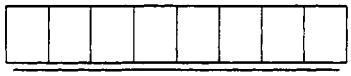
(a) Transmission

Send command [0][2] and data No. [9][1].

Command	Data No.
[0][2]	[9][1]

(b) Reply

The slave station sends back the requested command pulses.



Absolute value is sent back in hexadecimal in the command unit.
(Must be converted into decimal)

For example, data "000186A0" is 100000 [pulse] in the command unit.

(3) Software version

Reads the software version of the servo amplifier.

(a) Transmission

Send command [0] [2] and data No.[7] [0].

Command	Data No
[0] [2]	[7] [0]

(b) Reply

The slave station returns the software version requested.

Software version (15 digits)

REVISIONS

*The manual number is given on the bottom left of the back cover.

Print Data	*Manual Number	Revision
Feb.,1999	SH(NA)3200-A	First edition
Oct.,1999	SH(NA)3200-B	Deletion of 2(3)(a) in COMPLIANCE WITH EC DIRECTIVES Section 1.3: Rating plate changed Section 3.2: Corrections made to CN1B-4 and CN1A-18 connections Section 3.3.1 (1): Addition of CNP1/CNP2/CNP3 signal arrangement Section 3.3.2 (1): Corrections made to the Control Mode columns of the clear, control change and analog torque command signals Section 3.3.2 (2): Reconsideration of the sentence in the Functions/ Applications column of the warning signal Correction made to the maximum pulse width in the Functions/Applications column of the encoder Z-phase pulse Section 3.3.2 (3): Correction made to the sentence in the Functions/ Applications column of the digital I/F common signal Section 3.4.1 (1)(b)1): Corrections made to the transistor timing chart Section 3.4.3 (3)(a): Reconsideration of description Section 3.6.1: Reconsideration of common line connection Section 3.6.2 (4)(a): Addition of maximum output current Section 3.7.3 (4): Addition Section 4.2.2 (7): Addition of description for the servo motor equipped with electromagnetic brake Section 4.2.3 (6): Addition of description for the servo motor equipped with electromagnetic brake Section 4.2.4 (6): Addition of description for the servo motor equipped with electromagnetic brake Section 5.1.2 (2): Initial value of parameter No. 1 changed Section 5.2.1 (2): Addition of setting for use of AD75P Section 5.2.3: Description of stopping method changed Section 6.4 (3): Reconsideration of writing Section 6.6 (3)(b): Correction made to the abbreviation of reverse rotation start Section 7.2.2: Corrections made to the block diagram Section 7.4.2 (2)(a)4): Reconsideration of writing Section 7.4.2 (2)(b): Reconsideration of writing Section 7.4.3 (2): Reconsideration of writing Section 7.4.4 (2)5): Reconsideration of writing Section 9.1.1 (2): Addition of measures against position shift Section 9.2: Reconsideration of description related to alarm deactivation Section 9.2.2: Deletion of the cause 4 of A.16 Section 10.1: Indication of the power supply capacities on a motor capacity basis

*The manual number is given on the bottom left of the back cover.

Print Data	*Manual Number	Revision	
		Section 10.2.2 (1):	Addition of the outline drawings of connector 10120 -3000EL and shell kit 10320-52A0-008
		Section 11.1:	Addition of description related to load during a stop
		Section 12.2.1 (2):	Addition of finishing OD Changes made to the core insulation sheath outline d of J14B1180 Changes made to the number of cores of UL20276AWG28
		Section 12.2.4 (1)(c):	Figure correction
		Section 13.1.1:	Corrections made to the outline drawing and connection diagram
		Section 13.1.2 (2):	Corrections made to the connection diagram
		Section 13.12.1:	Reconsideration of all sentences

MITSUBISHI ELECTRIC CORPORATION
HEAD OFFICE:MITSUBISHI DENKI BLDG MARUNOUCHI TOKYO 100-8310

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